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Tests to determine the deflection of tall steel skeleton buildings under heavy wind pressures have recently been made by Mr. W. L. Stebbings, C. E., of Chicago. Two sets of tests were made, one on the 17-story Monadnock Block and one on the Pontiac Building, and both agree in showing the effect of the wind to be very slight. At the Monadnock Block the deflections were first observed by transits set in sheltered positions at points north and south of the north and south ends of the building and those observations were checked by observing the oscillation of plumb-bobs suspended in the stairway shaft from the 16th floor. These two observations agreed very closely and show the vibration east and west to be from ½ in. to ¼ in. According to the plumb-bob test the vibration of the building north and south or longitudinally was curiously enough greater than the vibrations east and west or transversely. It was considered that this could, perhaps, be accounted for by the fact that the building has a heavy transverse wind bracing, while there is no bracing longitudinally, except, of course, the ordinary floor girder and column connections. It was also found from the transit observations that the north end or old portion of the building, which has solid masonry walls, showed a smaller deflection than the south end or new portion, which is of the typical steel skeleton construction, with curtain walls carried by the framework. The time required for a complete vibration was about two seconds. The observations made on the Pontiac Building agreed quite closely in their general features with those made on the Monadnock Block, although owing to its sheltered position the amplitude of the vibrations was somewhat less. The same peculiarity of greater longitudinal than transverse vibrations was also noted here. The wind registered a velocity of a little over 80 miles per hour and was from the northeast. While a single series of tests cannot be considered as showing conclusively the amplitude of vibrations in tall buildings under heavy winds, yet considerable care was taken in conducting these tests, and as far as they go they show that the movements of well designed and constructed buildings of the steel skeleton type are very slight.

Electrolysis of water mains is said to be making havoc with the Wilmington, Del., water-pipes. On a street in which an electric railway ran, a 6-in. main was found to be badly perforated, holes as large as 1½ ins. in diameter being found. The service pipes along the main was also affected 40 cs., lead pipe being corroded to 12 cs.

The people of Afghanistan, says "Indian Engineering," view with considerable dissatisfaction and alarm the tunneling going on in the Khojak Pass. One high official, when invited by the engineer to see the great work, is said to have bitterly asked whether it was customary to invite a man to admire the hole which a bullet had made through his father's body.

The two steamships now being built by Wm. Cramp & Sons for the International Navigation Co., American Line, will exceed anything of their class built in the United States. They will have the following dimensions: Length over all, 554 ft.; beam, 63 ft.; depth, 42 ft.; 11,000 gross tonnage. Each will be propelled by twin screws operated by two quadruple expansion engines, on four cranks, and with steam at 200 lbs. pressure, they will develop about 20,000 collective I. HP. The outboard shaft bearings will have the two steel bosses cast in one piece, weighing 68,000 lbs. Each ship will carry about 320 first, 200 second-cabin and 900 third-class passengers. They will be so built, in accordance with the postal subsidy law, as to be easily converted into armed naval cruisers.

Proposals for engineering services were called for by the City Council of Wapakoneta, O., by advertisement in Engineering News of Feb. 8, the call being for revising plans and specifications and superintending the construction of water-works estimated to cost $60,000. On Feb. 15 the council opened 41 proposals and found that the lump sum bids varied from $500 to $3,000. From this number the council selected the following bids as the most desirable: J. W. Hill, Cincinnati, 1½% of cost of construction and traveling expenses; Geo. Hornung, Cincinnati, 2¼% of cost, supervision by an assistant and personal bi-weekly visits: J. P. Martin, Xenia, 1½% of cost, supervision by assistant and personal visits weekly. We are not advised as to which of the three has been finally selected.

The most serious railway accident of the week was a rear collision on the Canadian Pacific Ry. near Newburg Junction, N. B., Feb. 23. A wrecking train was returning from its work and was run into by the night express from Presque Isle. One man was killed and another very seriously injured. Misunderstanding of orders on the part of the station agent or the conductor of the wrecking train was the cause of the accident.

The boiler of a drainage machine near Houma, La., exploded Feb. 19, killing three persons and injuring six others.—The boiler of an oil mill at Campte, La., exploded Feb. 21, killing five persons.

Another incendiary fire at the World's Columbian Exposition caused the destruction of the greater part of the Agricultural Building, including the dome, on Feb. 24.

Com. George W. Melville, Engineer in Chief of the U. S. Navy, lately delivered a lecture before the Harvard Engineering Club on the training of engineers. He laid emphasis, among other things, upon the necessity of early gaining a practical as well as a theoretical education; upon the desirability of being able to express ideas in public, clearly and convincingly, and upon the advantages of being able to at least read French and German technical literature.

The Pennsylvania R. R. Co.'s bridge across the Schuylkill River, in Philadelphia, leading to the Broad St. Station, has been replaced by a stronger, three-track Pratt deck bridge. This work was commenced in June, 1893, and has just been completed without interrupting traffic. There are two spans of 156 ft. 8 ins., and one span of 41 ft. 6 ins.

The receivers for the Nicaragua Canal Construction Co. report that on Feb. 29 the holders of 95,200 shares of stock had assented to the plan of reorganization, and that $190,000 had been paid in assessments. The time for depositing stock has been extended to March 5, 1894, after which date no stock will be received.

The latest "stupendous canal project" includes the proposed construction of a ship canal across the State of Michigan, from Lake Michigan to either Detroit or Toledo. Preliminary surveys are said to have already been made, and the feasibility of the scheme vouched for by competent engineers. While the usual millions are said to be "back of this project" and the names of prominent capitalists are mentioned as "interested," it is safe to say that this scheme will not be realized in the present generation. Shipping rates by lakes are too cheap, as compared with canal rates; and, moreover, the proposed canal is not in the direct line of traffic between the chief grain shipping points and the East.

The heavy hoisting machinery required in modern mining operations is well illustrated by the large Corliss winding engine which the Philadelphia Engineering Works have just begun for the Chamberlain Coal Co., of Pottsville, Pa., Francis A. Pocock, engineer. This engine is to have 34 x 60-in. cylinders and will use steam at 125 lbs. pressure from a battery of Stirling boilers. The engines have the Stevenson link controlled by steam reversing gear with an oil cataract. It is also provided with a sensitive Porter governor. The hoisting drums are 10 ft. in diameter and 10 ft. long and are controlled by powerful hand and steam brakes. The adjustment of the lift is effected by a toothed gear clutch, thrown in and out by worm gearing. The bearings of the main shaft are 17 ins. in diameter and 30 ins. long. The engine is required to lift an unbalanced load of 50,000 lbs. at the rate of 1,000 ft. per minute, equivalent to 1,535 HP. of work done. The total weight of engine and drums will be about 325,000 lbs.

The severe winter storms have caused much trouble on the Central Pacific Ry., two miles of snowsheds having been crushed in by the avalanches of snow launched against them. Rumor has it that the people of Nevada are again raising the question of petitioning the U. S. Government to build tunnels through the section most seriously troubled by avalanches. As this section is about 60 miles long, and the tunneling would be almost continuous, it is to be feared that more people than Nevada contains will have to petition before the government indulges in this piece of contract work.

Two 10-in. 500-lb. armor-piercing shells, made by the Sterling Steel Co., of Pittsburg, were fired at a 11½-in. nickel-steel armor plate, at Indian Head, on Feb. 17. The shells penetrated 14 ins. into the plate and its wooden backing, and then rebounded so little deformed that they could have been fired again from the gun. The naval authorities report the test as very successful.

The following contrast is made by the Philadelphia "Times" between the "Kearsarge," the fastest cruiser in the navy of 1864, and the "Columbia," the swiftest American cruiser of 1894:

	"Kearsarge."	"Columbia."
Length over all	214½ ft.	416 ft.
Length on water line	198½ ft.	412 ft.
Beam, extreme	33 ft.	58 ft.
Draft	15¾ ft.	22½ ft.
Engines, I. HP.	843	21,000
Displacement	1,550 tons	7,350 tons
Speed per hour	11 knots	22.8 knots
Cost	$272,000	$2,723,000
Material of hull	Wood	Steel

This is a telling record of the advance made in naval architecture in the last 30 years.

Ski-jumpers, using the Norwegian ski, illustrated in our issue of March 29, 1890, have for some time been holding tournaments in Minnesota. The contestants slide down a snow-covered incline or hill on their long wooden skates, and thence on to a snow-covered level ending in a vertical face. The object is to see who can make the longest jump through space, from this vertical wall to the snow incline below it. Mr. Torjus Hemmestvedt, of Red Wing, Minn., who has held the champion record of 104 ft., has lately beaten his own record by a jump of 120 ft. This is said to eclipse all records, either here or in Norway.

Type-metal is said to have been successfully substituted for platinum by a manufacturer of incandescent lamps, it having been discovered that the coefficient of expansion is almost identical with that of glass.

A cableway, of 650-ft. span, is proposed by Mr. W. J. Brewer, engineer, as a means of crossing the Devil's Dyke, near Brighton, says "Engineering." Owing to the expense involved and the light traffic expected a bridge is out of the question. Mr. Brewer proposes to carry a car on two parallel cables, supported at intervals of 25 ft. from a main suspension cable. The car cables would be under considerable tension, and sag but little. Each car would carry 4½ tons and be hauled by cable, or by the trolley electric system. A company has been formed to exploit the system of Mr. Brewer, and they are prepared to undertake the erection of a regular line on this modification of the telpher system, with switches, sidings and all the usual appurtenances.

A device for attaching corrugated, galvanized iron roofing to the iron frame of the roof, as used in Austria, is worthy of notice by all builders. As usually fastened, the hole for the screw or bolt is put in the concave part of the corrugation, and the sheets soon rust at the hole thus made, and leak. The Austrians pierce the necessary hole at the top or convex part of the corrugations and use a longer bolt with the head outside. When this bolt is drawn up the elasticity of the sheet in this convex part causes a tight fit between the metal and the head of the bolt, and a thin washer of lead makes this fit perfect and absolutely water-tight, and rusting is obviated.

A "quarter-in-the-slot" gas meter is being tested by the San Francisco Gas Company, which has imported 75 machines for trial. The machine is so constructed that for every quarter dollar dropped in the slot. 125 cu. ft. of gas will pass through the meter. When this amount has been used a valve is closed, shutting off the supply until another coin is dropped in. As many as 16 quarters can be deposited at one time, and the meter will pass 125 cu. ft. for each quarter deposited. When the supply of gas paid for is nearly used up the lights burn low and the consumer is warned to make another payment or be left in the dark. These meters are also undergoing trial in New York city.

PROPOSED ENGINEERING SUPERVISION OF VIRGINIA HIGHWAYS.

A special committee of the Virginia Association of Engineers has prepared a bill, now before the legislature of that state, which has for its especial, and practically only, purpose the creation of a competent engineering organization to take care of the construction and maintenance of the public roads of Virginia. A late decision of the Virginia Court of Appeals rules that the existing road law, with its working-out tax system, is illegal and unconstitutional, and the present time is regarded as especially favorable for the presentation of new laws on this head and the passing of the same.

The proposed bill first creates a state engineer, at a salary of $3,000 per annum and actual traveling expenses, and requires a bond of $10,000. This engineer is appointed by each succeeding Governor for the three years' term of the Governor himself; though it is especially provided that the engineer may be reappointed if the Governor is so disposed, and the engineer may be removed for cause at any time. The duty of the state engineer is to compile statistics relating to the public roads and town and county bridges with regard to their safety; he is to prepare maps showing the county, city and town boundaries with all public roads and bridges; and he is to collect and collate information relating to the geology of the state as far as this geology relates to road location and material. These maps, reports, etc., are all to remain at the office of the state engineer in Richmond, and be accessible at all reasonable times to the inspection of the road officers of the counties, cities and towns.

The state engineer appoints his own staff of three members, and with the approval of the Governor, he appoints a district engineer for each of the three districts, into which the bill divides the state. The state engineer must devote his whole time to his office and annually report to the Governor, in full detail, all that has been done during the year, the recommendations for new work, and a general statement of the condition of roads and bridges at the time of making the report.

The three district engineers are to be paid $1,800 per annum each, with actual traveling expenses. They have, under the control and direction of the state engineer, direct charge of all state engineering work in their districts, and for this area perform very much the same duties as are required of the state engineer. Copies of all maps, plans, records and information relating to that district are kept in the office of the district engineer and are accessible to all local officers interested. The district engineers may appoint, for their own term of office and with the approval of the state engineer, county engineers, at $900 per annum in full, who shall have control in one or more counties as deemed necessary. These county engineers must live in the county or counties over which they have jurisdiction, and are always under the control of the district engineer.

Immediately after the passage of the act, it is provided that the state engineer shall call a meeting of the supervisors in each county in the state, to meet at their respective county seats, and to there join with any engineer designated by the state engineer in the classification of all roads in each county not included within municipal boundaries. Against the classification here provided for there is appeal within a reasonable time, but the decision of the state engineer on this head after this time has elapsed is final and binding. Annually during the month of March, there is to be a meeting of supervisors in each county to locate and lay out new roads, etc., or to change roads.

The state engineer may be consulted free of charge by all state officers upon engineering matters, and may be consulted by county, city and town officers on matter relating to the roads or bridges of their sections. The state engineer must advertise all state work on roads and bridges for 30 days; and, finally, open proposals and award the work to the lowest responsible bidder. Work not exceeding $500 in cost may be performed by him by day's labor. A specific state tax was to be levied to meet the expenses of the proposed act.

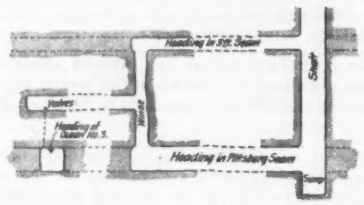
DRAINING A FLOODED MINE; AND THE PERMEABILITY OF STRATA TO AIR.*

By Beverley S. Randolph.

The coal measures of George's Creek coal region, in Maryland, lie in a comparatively flat synclinal basin about four miles wide. The dip of the measures is, in places near the edge of the basin, as much as 20 ft. in 100. The Pittsburg seam, known locally as the "Big Vein," is the only seam worked at the present time. Ocean No. 3, one of the large mines of the Consolidation Coal Co., has its opening on the outcrop of the Pittsburg seam, in a ravine which cuts into this seam to such an extent as to bring this opening to within a mile of the axis of the basin.

After working all the coal to the rise of this point the mine was further developed by extending a slope down the dip of the seam, making such an angle with the line of greatest dip as to give a grade varying from 1% to 10%, down which the empty cars carry a rope from a single drum winding engine. The coal was worked from each side of this slope in successive lifts during its progress. From the top of the slope for a distance of 4,000 ft. to the fourth lift the water is drained by gravity through a heading into the adjoining mine. Below this point the water was pumped into this same heading at the fourth lift, from which point, as before mentioned, it flowed by gravity. In March, 1891, the pumps used for draining this portion of the mine were overpowered by an unexpected rush of water, and these lower workings were temporarily abandoned and allowed to fill.

It was then determined to sink a shaft to reach the seam near the foot of the slope, in order to install a large pumping plant with boilers at the top of the shaft. Owing to the hilly nature of the country the most available point for this shaft proved to be near George's Creek, at a distance of about 800 ft. from the nearest heading of Ocean No. 3. The depth of shaft required was about 250 ft. An area of unworked coal lying north of the slope and below the fourth lift was attacked in such a way that the water from the portions of the mine already open could not flow into it, and the output of the mine was thus maintained, while the lower levels were allowed to fill and the shaft was being sunk. During this time these lower levels filled



Section of Shaft Showing Method of Tapping Flooded Heading.

with water up to the before-mentioned drainage heading at the fourth lift, giving a head of about 80 ft. when the water was eventually drawn off.

The coal of the Pittsburg seam in this district is very soft and friable and has frequent "slips" or planes of fracture lying at every imaginable angle, along which the cohesion is practically nothing. To approach this body of water, with its head of 80 ft., through such material, was a hazardous undertaking. Not only must the men be safely withdrawn after the water was tapped, but the subsequent flow must be rigidly controlled, since it flowed into the small sump of the shaft, and from there was lifted to the surface by the pumps. Any water in excess of the capacity of the pumps would, therefore, flood them and stop operations. To meet these conditions the following method was adopted:

From the foot of the shaft a heading was driven in the Pittsburg seam to within about 100 ft. of the heading of Ocean No. 3, from which it was proposed to draw the water. At the same time a heading was also driven, parallel to the first, in a seam of coal about 5 ft. thick, lying some 40 ft. above the Pittsburg seam. These headings were connected at their faces by a short vertical winze. From a point about 12 ft. above the top of the Pittsburg seam a drift was driven from the side of this winze to a point immediately over the heading of Ocean No. 3. This drift was located at this height because the first 6 or 7 ft. over the Pittsburg seam are very friable and liable to fall, and it was desirable to have several feet of solid rock under the drift, through which to bore to the water.

Several pieces of cast iron pipe, 4 ins. internal diameter, with flange on one end, were sunk in the floor of this drift, immediately over the heading of Ocean No. 3, and securely cemented and fastened down with straps and bolts. Common gate-valves were then bolted on the flange ends of these pipes which were uppermost. A drill measuring scant 4 ins. was then inserted through the open gate-valve, and holes were drilled through to the water. The drill being withdrawn and the valve closed, the water could then be admitted to the shaft as desired. One hole supplied the capacity of the pumps for several days, and others were opened as needed. When the water had run down to the level of the valves the intervening rock and coal were gradually broken down.

An instructive incident, bearing upon the permeability of natural strata to air, occurred during the draining of this mine. When the water was rising in the workings a considerable quantity of air was entrapped in the rooms opening out from one of the headings. This portion of the mine was abandoned to the water about 18 months, and during probably half that time the water was overflowing at the fourth lift, giving a head of 40 ft. at the face of the rooms. Subsequent examination revealed the fact that the rooms had been thoroughly filled with water to the roof, and the air must therefore have been forced out through not less than 200 ft. of solid coal.

When the first opening from other workings was made into these rooms the surface of the water on the slope was about 10 ft. lower than the face of the rooms. A violent rush of air into the rooms occurred, and the water rose suddenly on the slope about 7 ft. vertically. The air had not been able to follow in through the coal as fast as the water was taken out, the vacuum representing a water column 7 ft. high. The time during which the water was lower on the slope than the face of rooms, and the air was therefore being drawn into these rooms, was about two weeks. It is to be regretted that more accurate data were not obtained in regard to this phenomenon, but its importance was not realized until too late.

Some years ago, in the same seam, the writer had occasion to drive into a heading which had been driven over an anticlined dome, that is, a point from which the seam dipped in every direction. The heading was filled with water, so as to cut off the portion passing over this anticlinal dome from the remainder of the workings; and in order to escape from it the air would have to pass through the roof at right angles to the stratification. The head of water supported by the imprisoned air when reached was about 3 ft., and the marks on the side of the heading indicated that the water had never reached the roof, although at one time the imprisoned air had supported a head of upward of 80 ft. It is therefore to be inferred that air will pass slowly through soft semi-bituminous coal, but will not pass, to a perceptible degree, through slate rock at right angles to the stratification.

* Abstract of a paper presented at the February meeting of the American Institute of Mining Engineers at Virginia Beach, Va.

CONSTRUCTION OF THE SECOND TRACK OF THE ST. GOTHARD RY.

The completed second track of the St. Gothard Ry. was opened to traffic in May, 1893. For the details of construction and the accompanying illustration we are indebted to the "Schweizerische Bauzeitung," from which periodical we abstract the following description. The construction of a single-track tunnel in France, with a view to double-track widening later was described in our issue of Dec. 25, 1886.

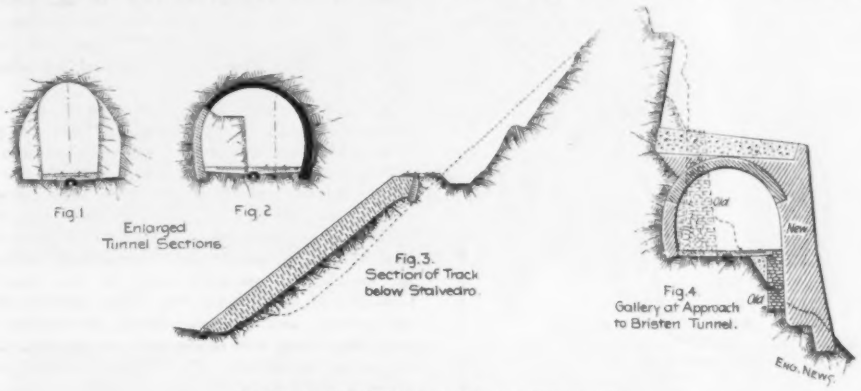
The main tunnel and four of the smaller ones on the line had, when first built, been arranged for double track; the other 26 tunnels on both approaches (from Erstfeld to Goeschenen, and from Airolo to Biasca) had only been constructed for single track. The Pressel-Kaufman type of cross-section had been employed in their construction, admitting of future enlargement, as shown by illustrations, Figs. 1 and 2.

In those tunnels 38,500 lin. ft. had to be enlarged and lined in part, requiring the removal of 243,000 cu. yds. of material and the construction of 38,000 cu. yds. of masonry. Generally the two tracks were constructed parallel; in some locations, however, crossings of the tracks were necessary, so that parts of the original superstructure had to be shifted. In some instances the roadbed had to be widened on both sides, necessitating the change of axis of the double track. The minimum distance between centers of tracks was fixed at 11.5 ft.

The most difficult and dangerous part of the work was generally carried on by the company itself, while the remainder was let to contractors, who were furnished with cars, rails, transfer and turntables free, and explosives at cost price. The earth and rock excavated and transferred amounted to 690,000 cu. yds. For the widening of a number of high embankments on one of the approaches about 100,000 yds. of debris excavated during the construction of the great tunnel were hauled nightly

from the old spoil banks. One of the widened embankments, 85 ft. high, is shown in Fig. 3. On some other embankments the roadbed was enlarged by building dry walls.

The work in the tunnels was carried on mostly at nights, as the intervals between trains were longest then. The excavated material was taken away by five-ton platform cars, which could be removed from the track by means of transfer tables. At the approach of the Bristen tunnel a gallery, 120 ft. long, was built, instead of cutting away the precipice, which had been supported before by masonry pillars, as shown by Fig. 4. The widening of masonry structures was effected by carefully dressing the rock projections of the old masonry and having the new masonry butting against the old. For the widening of bridge piers and culverts an amount of 48,000 cu. yds. of masonry was required. The bridges for the second tract were almost exclusively built of basic steel. The trusses were constructed on the double intersection system with verticals. Some of the existing bridges, being in the axis of the double-track road, had to be shifted laterally, this work being carried on Sundays between passenger trains, as no freight trains were running then.



DOUBLE-TRACKING OF ST. GOTHARD RY.

The new superstructure of Airolo-Faido division was laid with steel rails, 75 lbs. per yd., 39 ft. long, with 15 steel ties, 127 lbs. for each rail; in the longer tunnels steel rails, 97 lbs. per yd., 39 ft. long, were used; for the rest of the track rails weighing 93 lbs. per yd. were used. The ties on those sections were of steel, 145 lbs.; 16 under each rail. The protection of the work was effected by special stations. At nights no train was allowed to proceed through tunnels from adjacent stations until reliable information had been obtained stating that the track was clear. Each working detachment was provided with electric or hand signals. On account of the continuous down grade on each side of the great tunnel, gravity railroading was resorted to in that section.

The construction of the second track of the St. Gotthard Ry. required 5½ years; the original cost of the line amounted to $48,000,000, the great tunnel requiring an expenditure of $12,500,000. The total cost of construction for the second track was $2,500,000.

OUTLET GATES OF THE BEETALO WATER-WORKS RESERVOIR, SOUTH AUSTRALIA.

A water-works system providing a supply for irrigation and domestic purposes to an area of 1,715 sq. miles, including several towns, was completed two years ago or so in South Australia. The principal feature of the system is a concrete dam 107.7 ft. high above the ground level and 118.5 ft. from bottom of foundations to crest, impounding nearly a billion gallons of water with a maximum depth of 102.7 ft. A pipe line 12 and 8 ins. in diameter and 80¼ miles long forms the main artery of the system, from which extend branches down to 2 ins. in diameter. The average rainfall in the district supplied is about 13 ins. and in the catchment area of the reservoir, for the past ten years, 24.24 ins.

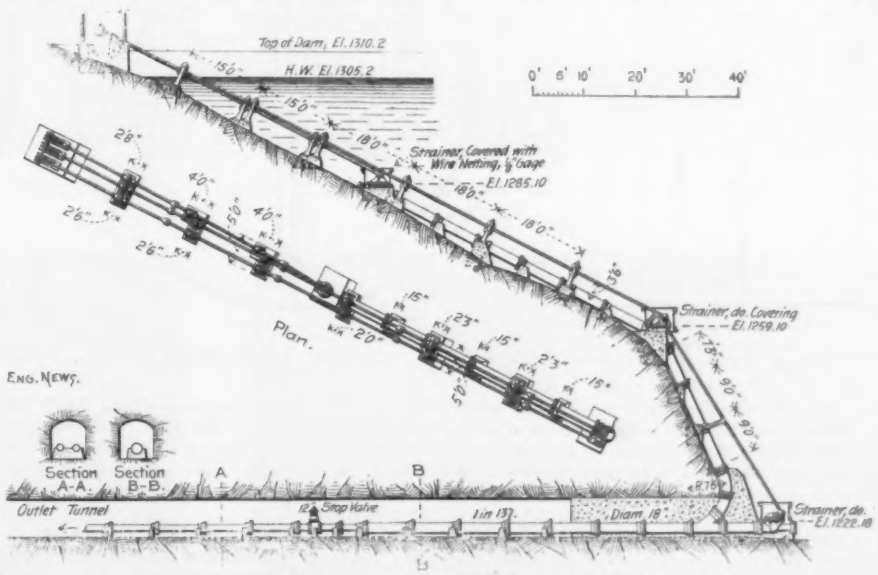
In Engineering News of May 30 and Sept. 19, 1891, the dam was described and illustrated. A paper describing the works in detail has recently been printed in the Proceedings of the Institution of Civil Engineers. This paper was prepared by Mr. Christopher Jobson, Assoc. M. Inst. C. E., and from it the accompanying information regarding the outlet gates and pipe of the main reservoir has been taken.

To avoid carrying the 18-in. outlet pipe through the dam a tunnel was driven through the adjoining hill, and to take water at points above the bottom of the reservoir without the expense of a valve tower, a branch from the outlet pipe was carried from the mouth of the tunnel up the side of the reservoir slope, as shown by the accompanying drawing. The apparatus for operating the valves and the valves and strainers, are described by Mr. Jobson, as follows:

The valves are of a common flap pattern, and are worked by rods 1¼ ins. in diameter, running up to the valve-house. The rods are connected with long screws, working into female screws formed in the bosses of hand-wheels, 2 ft. 3 ins. in diameter; three cast iron brackets carry the bearings of the hand-wheels. The rods running to the valve-lids are supported by pulleys carried by cast iron brackets, bolted to concrete blocks, spaced 15 ft. to 18 ft. apart. At the sharp angle in the profile of the hillside the change of direction is made in the rod working the lowest valve by means of a cast iron bracket lever. Another cast iron lever is fixed to prevent bending of the rod when closing the valve in the event of its sticking.

Over each valve a galvanized wire gauze strainer 5 ft. in diameter by 3½ ft. high is fixed. These strainers were covered by ½-in. galvanized iron plate, and the sides by galvanized wire gauze, ⅛-in. mesh; but the usefulness of this apparatus in excluding foreign bodies from the pipe is somewhat reduced by the long slotted apertures in the cover plates, through which the valve rods pass. The strainers are bolted to the concrete blocks upon which the valves rest, and can only be reached for cleaning or repairs by either running the water off or sending a diver down. This part of the works was thus designed and adopted by the engineer-in-chief for the sake of cheapness.

Mr. Jobson was resident engineer of the dam. The work was under the direction of Mr. R. L. Mestayer, M. Inst. C. E., Hydraulic Engineer to the South Australian Government, until that office was amalgamated in May, 1888, with that of the engineer-in-chief, when, by virtue of his position, Mr. A. B. Moncrieff, M. Inst. C. E., became chief engineer of the dam.



OUTLET GATES, BEETALO RESERVOIR, SOUTH AUSTRALIA.

THE UNITED STATES COAST AND GEODETIC SURVEY.

Bulletin No. 29 of the U. S. Coast and Geodetic Survey treats of the methods and results of the survey as illustrated at the World's Columbian Exposition. From this bulletin the following general points of information are gathered concerning this important technical branch of the government:

The National Coast Survey was established in 1807 upon the recommendation of President Thomas Jefferson. For the purpose of furnishing geographical positions and other data to state surveys, the scope of the bureau was enlarged in 1878, and the name was changed to the U. S. Coast and Geodetic Survey. The field of operation covers the 30,000 miles of coast line of the United States, not including Alaska, which is of itself almost as extensive. A line of triangles, beginning at the eastern boundary of Maine and extending nearly to the Gulf, is now nearly completed and forms the base of operations along the Atlantic Coast. And an extensive system of triangles, to extend across the continent on the 35th parallel of latitude, is now rapidly approaching completion.

In the New England States, New York and several Western States, including California, these principal triangulations have been considerably expanded and some exceptionally large figures introduced. The longest line so far observed is the 190-mile stretch between Mt. Helena and Mt. Shasta. A tertiary triangulation for topographic and hydrographic purposes has been completed along the entire Atlantic and Gulf coasts, and over more than half of the Pacific Coast, excluding Alaska. The topographical observations have been mostly restricted to a belt, seldom over three to five miles wide, along the coast and surrounding harbors, bays and rivers to the head of tidewater. The hydrographic surveys extend as far from the coast as is necessary for the interests of navigation, and include all harbors, channels, bays, etc. The principal publications of the survey include about 500 different charts and tide tables for all the principal and many minor ports.

As a matter of interest it may be stated that no other government has carried forward so thorough and accurate a system of surveys over so large a section of the world's surface as the United States. This system of surveys reaches from Etang Harbor, Province of New Brunswick (lat. 45° 03', long. 66° 47'), to the Pribilof Islands, Alaska (lat. 57° 10', long. 170° 20'), covering 61 degrees of a great circle, or 4,224 statute miles. The

most northern point is Camp Colonna, Alaska (lat. 67° 23′, long. 141° 0′); the most southern point is Key West, Florida (lat. 24° 30′, long. 81° 50′); the distance between these points is 3,835 statute miles.

The extent of general coast line on the Atlantic is 3,895 miles; on the Pacific, 1,810 miles; and in Alaska, 4,750 miles. These are lines simply following the general trend of the coast, and make no note of minor irregularities. The actual coast line in Alaska would have a length of about 26,364 miles, if we take in the Aleutian Islands, bays, inlets, islands, etc., from Dixon Entrance to Point Barrow.

The area covered by the survey on the Atlantic Coast is 28,950 sq. miles; on the Pacific Coast, 5,280 sq. miles; in Alaska, 720 sq. miles; and resurveys, 2,450 sq. miles. This represents a total of 37,400 sq. miles. The belt of topography on the Atlantic Coast averages about 7.4 sq. miles per linear mile of general coast line.

The work of the survey is contained on 2,240 original sheets, generally on a scale of 1-10,000. On the southern Atlantic Coast, for simple topography of small relief, the scale of 1-20,000 has been adopted, and some expert work on the coast of California is on the scale of 1-40,000.

THE TUNNEL OF THE EAST RIVER GAS CO.

For the purpose of piping gas from their works at Ravenswood, Long Island, to New York city, the East River Gas Co. determined to drive a tunnel under the East River and under Blackwells' Island at the location shown on the map and profile herewith published. This tunnel project was the result of a legislative franchise, permitting the company to lay pipes and distribute gas in New York city, obtained in April, 1892. The services of Mr. Charles M. Jacobs, an English civil engineer of extensive experience in similar work in England and Australia, were at once secured and soundings and borings were made on the line of the proposed tunnel. After the plans were completed the work of driving the tunnel was originally let to the contracting firm of McLaughlin & Reilly.

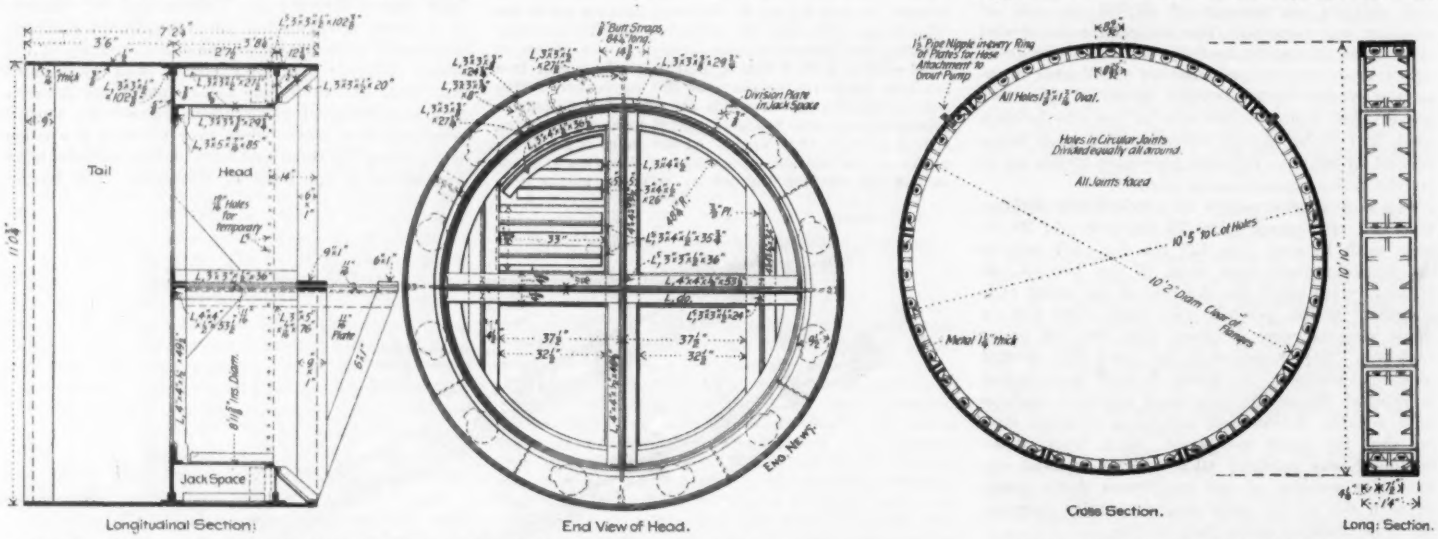
Map Showing Location of Tunnel of East River Gas Co.

As located the tunnel was 2,516.4 ft. long from center to center of the two shore shafts; though the actual length of the tunnel will be 2,566.4 ft., an extension of 25 ft. beyond center of shaft at each end having been made for purposes of alinement, etc. The center line of the tunnel is about 107 ft. below mean low tide on the New York side, and about 119 ft. below the same level on the Ravenswood side, thus giving a final drainage toward the latter point. The shafts themselves are 9 ft. square and are 135 and 147 ft. deep below the ground surface, for the New York and Ravenswood side, respectively.

The solid rock section is 10 ft. wide by 8 ft. 6 ins. high at the crown, the roof being struck with a radius of 7 ft. and joined to the perpendicular sides by curves of 2 ft. radius. Work on the tunnel was commenced on the New York side, and for 342 ft. east of the shaft the rock was dry and work progressed rapidly through the gneiss usually found under New York city. On the Ravenswood side, begun about the same time, many springs were encountered in the rock and considerable pumping was necessary in driving the 285 ft. of tunnel at that end, and soft ground was encountered about 250 ft. west of the center of the east shaft.

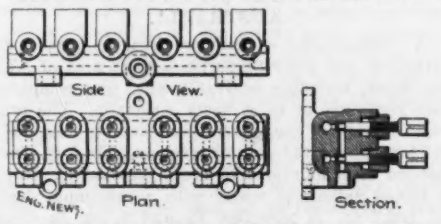
Trouble began early in 1893, principally at the New York end. When the heading had reached a point about 342 ft. from the shaft the rock altered wholly in appearance and for a horizontal distance of 28 ft. it presented thin successive, almost vertical, layers of decomposed feldspar; a greenish, marl-like formation that ran like paint when wet; a coal-black streak containing lignite and beautiful rounded nodules of pyrites with almost perfect crystals, and, finally, a thicker talcose or soapstone stratum. After this, for a distance of about 100 ft., the rock was somewhat harder, but still requiring lining, and then 90 ft. of the soft material previously described was again passed through before sound rock was encountered. The first attempt to bulkhead and drive the tunnel under an improvised roof and centering was unsuccessful, and an air lock was finally installed and a plant secured for working with compressed air. At this time Mr. W. I. Aims, a civil engineer, who had had much previous experience in work of this nature on the Hudson River tunnel, was engaged by Mr. Jacobs to take charge of this portion of the work. The contractors, who had been granted an allowance for the extra work entailed by the soft material strongly advocated abandoning the heading thus far driven and the starting of a new heading on a level about 50 ft. lower. Mr. Aims properly protested against this, as meeting with similar obstacles at a depth of about 170 ft. below mean tide would render the use of air pressure impossible. The controversy ended in the abandonment of the work by the contractors and its continuation by the company under the direct charge of Mr. Aims and the direction of Chief Engineer Jacobs and his assistant, Mr. J. V. Davies.

After work had been recommenced under the new direction 28 ft. of the soft material was penetrated, by using a centering supported on iron ribs and braced from a central heavy timber in the axis of the tunnel, and then lined with brick masonry of circular section, 12 ft. in inside diameter. When the air pressure was removed it was found that the water penetrated through the brickwork in considerable quantity, and it was then determined to use a cast iron lining throughout all soft ground, and to pass through the bricked portion this lining was made with an external diameter of 10 ft. 10 ins. This lining is shown in the accompanying illustrations. At first it was used with a continuous overhead key; but for the purpose of breaking joint and tying the lining together more firmly, this key was "staggered," as shown in one of the photographic views. Originally, every other ring was provided with 1½-in. nipples for attaching the grout pump; but Mr. Aims changed this to a nipple in every lining segment, as he found the resulting grouting to be more thorough and yet more economical in the amount of grout used.



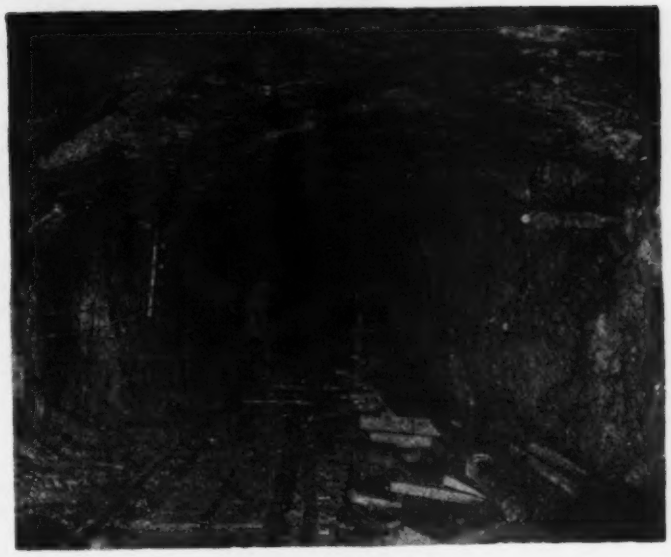
SECTION AND ELEVATION OF SHIELD USED IN SOFT GROUND IN EAST RIVER TUNNEL.

SECTIONS OF CAST IRON LINING.

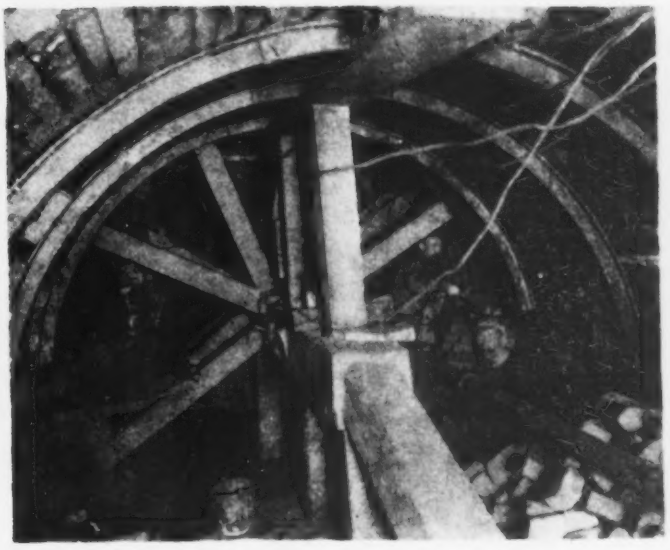


Battery of Cocks at Sides of Shield Controlling Flow to and from Hydraulic Jacks.

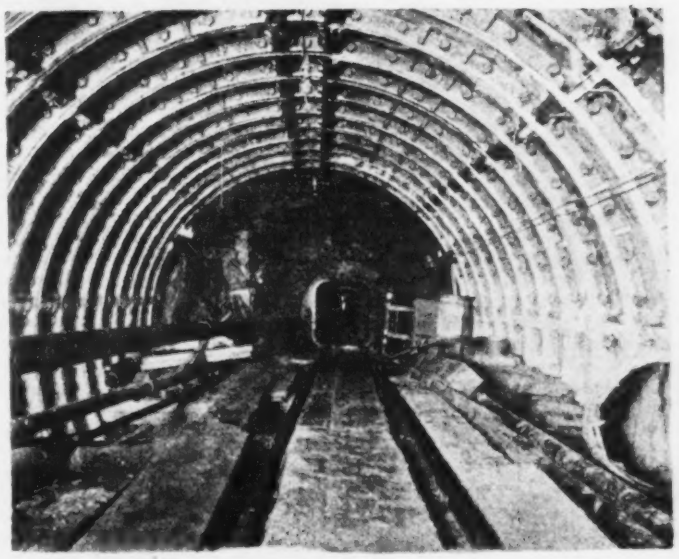
As before stated, beyond the first 28 ft. of soft material about 100 ft. of reasonably sound rock was encountered and penetrated; but beyond that the material was so soft as to require the use of a shield. This shield was planned by Mr. Aims, as herewith illustrated, in elevation and section, with its general dimensions. It weighs about 12 tons and is 11 ft. 0¾ in. in external diam-



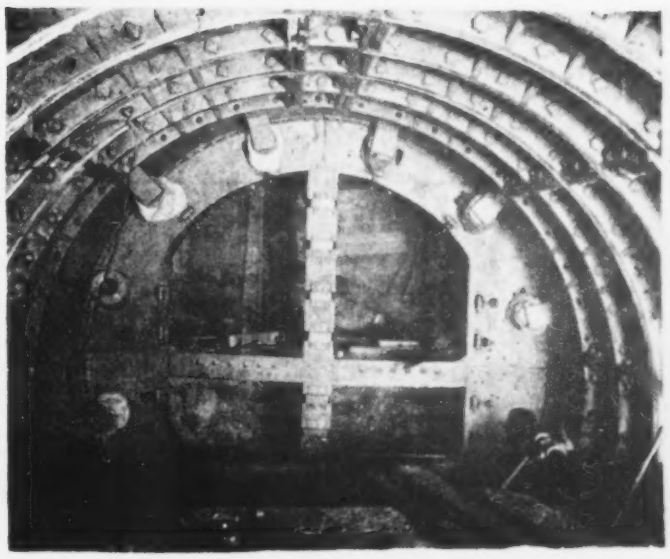
View of Tunnel in Rock.



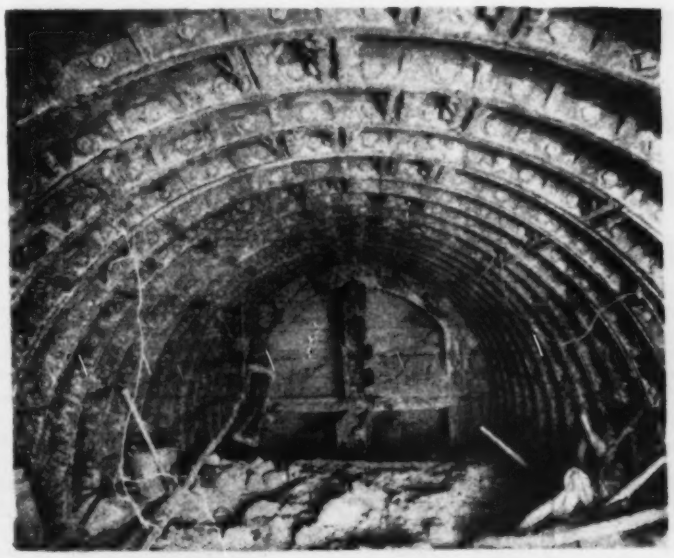
Working in Soft Ground; Timbering in the Heading.



The Air Lock in West Heading; View Looking toward Shaft.



Hydraulic Shield under Construction Back of Bulkhead.



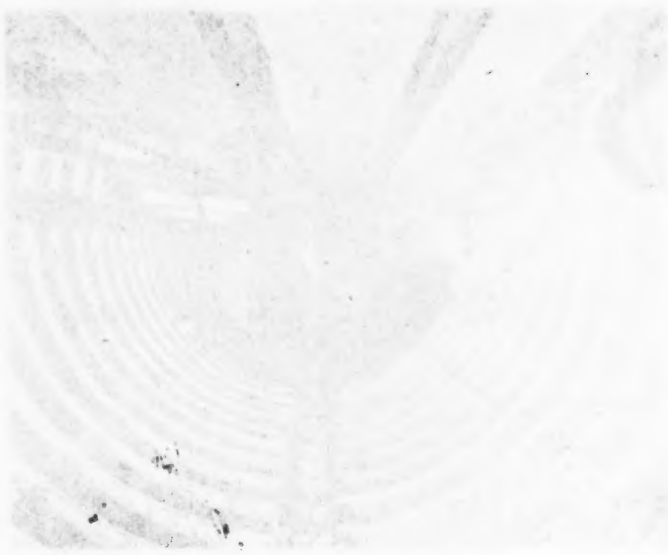
View of Cast Iron Lining Built with Broken Joints.

Hydraulic Shield Completed and at Work.
Cast Iron Lining Built with Matching Joints.

Photographs in the Tunnel of the East River Gas Co., under the East River, New York City.

Chas. M. Jacobs, Chief Engineer; J. Vipond Davies, Principal Assistant Engineer;
W. I. Aims, Resident Engineer. D. L. Hough, Chief Engineer East River Gas Co.

CHAS. HART & SONS, LITH., 30 VESEY ST., N. Y.



eter, and 7 ft. 2¼ ins. long. The cast iron lining is just enough smaller to permit of being put in place under the protectors of its rear end. The cutting edge of the shield is about 15 ins. deep to the outside of the annular space containing the 12 hydraulic jacks; and at the rear of the jacks, or about 4 ft. from the cutting edge, is placed a diaphragm provided with eight doors, as shown more fully on our inset sheet in the reproduction of the flashlight photographs of the inner end of the shield. This shield is pushed forward by the action of the jacks bearing against the cast iron lining already in place; the material is excavated and removed through the doors as the shield moves forward, and as soon as the space is provided an additional lining ring is bolted in place.

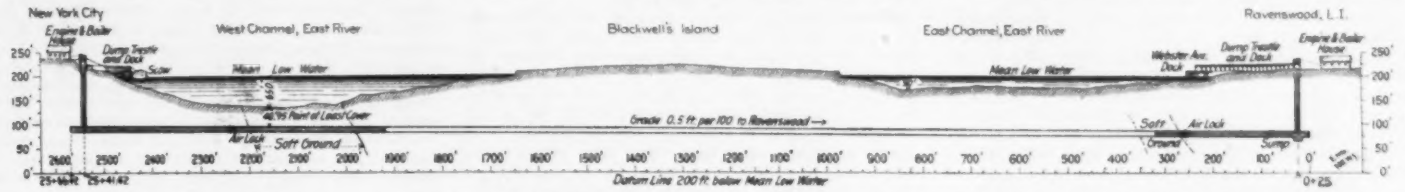
The twelve 5-in. jacks are designed to work under a hydraulic pressure of 5,000 lbs. per sq. in., furnished by a compact and simple pressure pump, built by Messrs. Watson & Stillman, who also furnished the jacks and all the hydraulic apparatus. It is possible to bring a pressure of 600 tons upon the shield to push it forward; and on several occasions the maximum pressure of 5,000 lbs. per sq. in. was applied. The shield and heading are lighted by incandescent lamps and a telephone connects the heading with the outer world.

As the axis of the tunnel is nearly 120 ft. below mean low tide, the air pressure required was very considerable and to the best of our knowledge surpasses in working pressure the record at any other work carried out on the plenum-pneumatic method. A pressure of 48 lbs. per sq. in. was used for some time, and somewhat heavier pressures, up to 52 lbs., are recorded on the Edson gage employed. In spite of a careful physical examination of the men employed, prior to their admission to the lock, 15 of the workmen suffered more or less from the "bends" and there were four fatal cases, death being due to carelessness in leaving or entering the lock. Mr. Aims, as a result of his previous experience on the Hudson River tunnel, had provided every precaution for the safety of the men working under this heavy pressure; but disorders so slight as to evade physical examination, combined with the inherent carelessness of the average workmen at times, rendered these precautions useless. The usual working hours were six, reduced to two hours as the pressure increased, alternating with two hours' work outside before entering again.

On the Ravenswood side, a progress of 295 ft. was made from the center of the shaft and an air lock was then installed. Beyond the air lock about 45 ft. of soft ground has been passed with 34 ft. of similar material ahead, as shown by boring. Beyond that there seems to be hard rock. The New York heading is at this date in a very hard, sound rock, 627 ft. from the shaft. There thus yet remains about 1,600 ft. of tunnel to be driven; but the engineers anticipate no especial trouble and believe all serious obstacles to be passed.

On the New York side, during the cessation of work resulting from the controversy with the contractors, the tunnel was temporarily bulkheaded. But during this time the percolation of water from the river above so washed out one of the thin soft seams as to establish direct communication with the river bed. This was shown by finding later in the tunnel a quantity of live crabs, and even old shoes, tins, etc., that once were in the river above. The rock bounding the soft material on the west pitched forward at the toe on a quite flat slope and made it difficult to start the shield, as the rock toe had to be blasted away before the shield could be advanced sufficiently to fully enter the soft material. This difficulty was finally overcome by using poling boards above and thus supplementing the shield until the bottom rock was taken out.

The decomposed rock met with in this tunnel calls to mind the somewhat similar experiences of the builders of the tunnel under the Harlem River for the New Croton Aqueduct, of 1887-88. In this case preliminary borings with a diamond drill indicated that sound rock was to be found at a depth of 150 ft. below the surface of the river and a shaft was sunk to that depth and a trial heading driven. When this heading had reached a point 300 ft. from the shaft, disintegrated and decomposed gneiss rock was found accompanied by much water. As the depth was in this case too great for the employment of compressed air, test holes were drilled from the end of this heading both downward and forward. The result showed a deep fissure under the bed of the Harlem filled with this decomposed material, but only 250 ft. wide horizontally on the line of the heading. The shaft was finally sunk to a depth of 307.5 ft. below mean tide and the tunnel driven on that level was so dry as to be dusty.

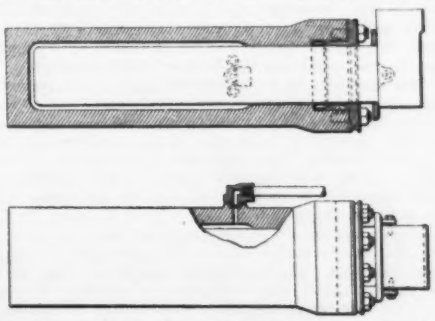


PROFILE OF EAST RIVER TUNNEL SHOWING PROGRESS TO FEB. 23, 1894. THE SHADED PORTION INDICATES THE FINISHED WORK.

SPECIFICATIONS FOR ARC STREET LIGHTING PLANT, DETROIT, MICH.

The city of Detroit received bids on Jan. 30 for the construction of a street electric lighting plant to be owned by the city and to include at the start 1,500 arc lights of 46 volts and 9.6 amperes each. This will be the largest municipal electric lighting plant in the country, that owned by the city of Chicago having about 1,100 arc lights. The specifications were the joint work of Messrs. Alexander Dow, M. Inst. Elec. E., and Jesse M. Smith, M. Am. Soc. M. E., and were very carefully drawn and complete. As the preparation of complete specifications and inviting formal proposals for such work is comparatively rare, we reprint these specifications in full.

Triple Expansion Engines.—There will be required five engines, which must have vertical marine frames, three cranks, and be condensing. Their power must be such that the best economy will be obtained when indicating in the cylinders 250 HP. as a minimum, and 340 as a maximum, with 160 lbs. initial steam pressure above atmosphere, and 26 ins. vacuum. Bidders will note the intention of the Commission to operate the engines within these limits, and will expect no credit for greater capacity in the engines they offer.



Elevation and Section of Hydraulic Jack Used for Advancing Shield.

The steam consumption by weight, within the limits of power, and with the conditions of steam pressure and vacuum stated in the preceding paragraph, shall not exceed 15 lbs. per I. HP. hour, including in the weight all steam used in jackets without credit for heat units saved by return of water condensed in jackets to boilers. The steam furnished for the test shall not contain more than 3% of moisture. The power absorbed by the engine in overcoming its own friction when the indicated horse power is 295 or more shall not exceed 12½% of the indicated horse power. The power absorbed is to be ascertained in the following described manner: The engine is to be run with four dynamos connected, the dynamos being loaded as nearly equal as may be and the power indicated under these conditions noted. Loading of dynamos to be sufficient to cause indication of not less than 295 nor more than 340 HP. Two dynamos (equal to one-half the load) to be disconnected from the engine by removal of belts, and the power then indicated to be noted. Then twice the difference between the indications of the two tests shall be held to be the delivered horse power; and the difference between the same and the power indicated with four dynamos connected shall be held to be the power absorbed by the engine.

The regulation is to be by automatic cut-off, either by positive motion of the valves under control of a shaft governor, or by drop cut-off under control of a fly-ball governor. Means for adjusting the cut-off by hand while the engine is running, in addition to the automatic governor, are also desired, but it is not imperative that such should be supplied.

The speed shall be not less than 190 nor more than 210 revolutions per minute. And the speed of the engine when the dynamos are doing no work, or are disconnected entirely, at option of the Commission, must not be more than five revolutions per minute greater than when the engine is developing in its cylinders 300 HP. The instantaneous increase of speed, as shown by a tachometer belted to the engine shaft, when one-half of the load or any less part thereof is thrown off suddenly, is not to exceed 4% of the normal speed when the engine is developing in its cylinders 300 HP. The piston speed shall be not greater than 600 ft. per minute.

The flywheels shall weigh not less than 15,000 lbs. and have a peripheral velocity not less than 4,200 nor more than 4,400 ft. per minute. There shall be at least two belt flywheels to each engine, each of which is to have 20 ins. width of face. If the belt flywheels are at ends of the shaft, they are to have outboard bearings. The Commission reserves the right to dispense with the belt wheels by giving notice of its intention to do so not later than 30 days after award of contract, and in such case to deduct the price of the wheels from the contract price of the engines. Bidders must name in their bids the price of the wheels.

The bearings must be fitted with removable shells, adjustable for wear, and no bearing shall be loaded to more than 60 lbs. per sq. in. of projected area. They shall be fitted with automatic reservoir oiling gear, and, in addition thereto, with large grease boxes.

Lubrication of cylinders must be by sight-feed lubricators and also by hand oil pumps, fitted to each cylinder, and of slides, cranks and other fast moving parts, by sight-feed cups of large size, or preferably by pipes with sight glasses from a central reservoir. Lubrication of valve gear and slow moving parts shall be by compression grease cups. The lubrication of main bearings is specified in preceding paragraph. Provision must be made for the prevention of throwing of oil on to floors, or elsewhere where not required, and for the return of waste oil to a single receiving reservoir.

Piston rod packings are to be metallic, and the throttle valve must have lever or other quick acting handle and be controlled from floor level as well as from the gallery around the cylinders.

Bidders will include in their bid the price of a first-class water separator for each engine, connected on steam pipe and as near engine as possible. They will include in their figures the connecting up of the separator and whatever pipe may be necessary between the engine and separator; also drain pipe valve, but not the drain pipe.

Bidders will state dimensions of foundations required by their engines, assuming that good bearing soil is to be had at a depth of 8 ft. below floor level, and that the rim of the largest wheel will be 1 ft. below the floor. They may either file a plan of the foundation or state its length, width and cubic contents. They will include in the price for engines the foundation bolts with footplates and finished nuts and the iron sub-base or the capstones which their plan of foundation requires. The brick or concrete work will be furnished and the capstones or sub-base set by the Commission.

Bidders will figure upon setting up the engines in the power house, on foundations described in the preceding paragraph, ready for steam and exhaust connections.

The contractor will guarantee each engine furnished by him to be fit for daily operation for 18 hours per day at normal speed and indicating 340 HP. or any less

power, and to be fit for operation for 10 consecutive hours at a speed 10% over the normal with the same mean effective pressure of steam in the cylinders as is required to cause the indication of 340 HP. at normal speed; to be free from defect of material, and to be perfect in workmanship; to be fit to withstand, without injury, the ordinary accidents of operation, such as the sudden throwing off or on of the entire load; and to be in all respects in accordance with the specifications, and in accordance with the statements made by him in his bid or in writing accompanying same.

Before acceptance of any engine by the Commission it will be operated on regular work by the Commission's employes for 90 days, during which time, in addition to the regular work of the lighting plant, the engine will be subjected to such examination and tests as may be considered by the Commission necessary to determine that it conforms to specifications and to the guarantees made by the contractor. The contractor or his representative will have free access to the engines during the 90 days, but is not to control or interfere with the operation or tests. Whether any engine does or does not conform to the specifications and to the guarantees made by the contractor shall be solely and finally determined by the Commission.

Compound Engines.—Bids are invited on compound engines, to be used in place of the triple expansion engines specified. Bidders on compound engines will be guided by the triple expansion specifications, excepting in the following respects: Engines will be two-crank. Initial steam pressure will be 125 lbs. above atmosphere. Steam consumption will not exceed 17½ lbs. per I. HP. per hour. Power absorbed by engine friction will not exceed 10% of the indicated horse power.

Supplementary Bids.—Bidders who prefer to operate their engines at steam pressures differing from those specified and to arrange their cylinders to suit the altered pressure may file supplementary bids, stating the advantage to be gained by the Commission by departing from the specified pressure. But no such supplementary bid will be received except on engines already offered under the specifications, nor except from the person offering said engines.

Water Tube Boilers.—There will be required seven boilers, the tubes, drums and other parts to be supported independently of the brickwork.

Each boiler must have a minimum heating surface of 3,000 sq. ft. and be guaranteed to evaporate not less than 9,000 lbs. of water at 100° F. into steam at 165 lbs. above atmosphere per hour. Bidders are invited to guarantee the duty of the boiler they offer, viz., the total evaporation per hour during a run of 10 hours under working conditions, or conditions approaching as closely thereto as may be, stating conditions in guarantee. Ten pounds of water from and at 212° is to be evaporated per pound of combustible, on a test run of 10 hours. Fuel for test to be clean Hocking Valley lump coal, and no cleaning of tubes to be done during test. Working steam pressure to be carried and usual corrections for same and for temperature of feed-water to be made in calculating the economy. The boilers must carry safely in regular work 165 lbs. and be tight under cold water pressure of 250 lbs.

The grates must be first-class rocking grates, of style suitable for burning "run of mine" soft coal, with grate area of not less than 75 sq. ft.

Bidders will figure upon the boilers set up in the power house, ready for steam and smoke connections. The Commission will furnish proper footings of concrete or rubblestone for the boiler walls upon the floor level, but not cut stones or foot plates for columns. They will set such stones or plates in the footings if the same are furnished by the contractors. Contractors will furnish all the material and labor for settings, except as above stated, material and workmanship to be of the best. Brick (except firebrick) to be the best common brick, laid in level courses with full beds and joints of mortar, the mortar to be one part lime and two parts sharp sand. Firebrick, laid in fire-clay mortar, to be used for all parts exposed to fire or to hot gases.

Boilers are to be equipped with pop safety valves, water columns, steam gages, etc., of the most approved kind. Bidders will file a detailed statement showing (1) material to be used in the construction of the boiler; (2) area of grate surface, heating surface, superheating surface; (3) list of equipment to be furnished with the boilers; (4) floor space, height and other principal dimensions; and (5) sketch and description of the manner of supporting the boilers independently of the brick walls.

The contractor will guarantee each boiler furnished by him to be free from defect of material and to be perfect in workmanship; and to be in all respects in accordance with the specifications and with the statement furnished by him in writing accompanying his bid.

Before acceptance of any boiler by the Commission, it will be operated on regular work by the Commission's employes for 90 days, during which time, in addition to its share of the regular work of the plant, it will be subjected to such examinations and tests as may be considered by the Commission necessary to determine that it conforms to specifications and to the guarantees made by the contractor. The contractor or his representative will have free access to the boiler during the 90 days, but is not to control or interfere with the operation or tests. Whether any boiler does or does not conform to the specifications and to the guarantees made by the contractor, shall be solely and finally determined by the Commission.

Additional bids are desired showing the further price at which bidders will equip their boilers with the Hawley down draft, or other smokeless furnace. If the Hawley furnace is offered, the surface of upper grate must be not less than 50 sq. ft. If the duty or economy of the boiler will be altered by the use of the smokeless furnace the alteration must be stated.

Bids for boilers other than water tube will be considered and detailed bids are asked for on boilers that will be guaranteed to produce the results specified above.

Dynamos for Arc Lighting.—There will be required 18 direct current dynamos, with constant current and varying voltage to operate arc lights in series. The output will be not less than 48, nor more than 50 k-w., and the current must be constant at 9 6-10 amperes. The commercial efficiency (i. e., ratio of net electrical output to power absorbed by the shaft of the dynamo) is to be not less than 86%. Guarantees of higher efficiency are invited. The speed shall not exceed 500 revs per minute.

The regulation is to be automatic from one lamp to full load. The current must not increase more than one-half ampere when the voltage is reduced from its maximum by steps of 500 volts or less at intervals of 10 seconds, to one-fifth of the maximum, and must not increase further, more than one-half ampere when the voltage is reduced to 50 volts, the voltage being taken at the lamp circuit terminals. The spark at brushes is not to increase so as to endanger the commutator or its insulation during regulation as described, and the setting of brushes to proper diameter of commutation is to be performed by the regulator or other automatic device, and not by hand. Regulation and setting of brushes for increasing load is to be at least as good as specified for decreasing load. Constant speed of driving is assumed, and credit for any variation will be allowed.

Bidders will furnish dynamo pulleys of proper size for 4,300 ft. per minute belt speed, but the commission reserves the right to dispense with the pulleys by giving notice of their intention to do so within 30 days of the award of the contract and in such case to deduct the price of the pulleys from the contract price of the dynamos, the bidders to name in the bid the price of said pulleys.

A base frame of hard wood, filled and varnished, having ratchet and screw for purpose of tightening belt, will be required with each dynamo.

The bearings are to be fitted with automatic reservoir oiling gear, with oil gage on reservoir, and in addition thereto to have sight-feed oil cups sufficient to maintain the oil supply in case of failure of the automatic gear, or to assist it in case of hot bearings.

The insulation is to be mechanically strong throughout, as well as of high electrical resistance, and of material guaranteed to retain permanently its insulating quality. Insulating parts exposed to the atmosphere are to be of material non-absorbent of moisture. If solid insulation is used between segments of commutator, said insulation is to be mica and the insulating ring between segments and heads is also to be mica. If the segments are insulated by air space, then the bottom or sides of the spaces must be of porcelain or similar non-absorbent, non-combustible material, and must be readily visible and accessible for cleaning. The insulation resistance measured from any or all conducting parts of the machine to the frame and magnet and armature cores is to be not less than five megohms.

The temperature of either field or armature windings is not to be more than 70° F. higher than that of the surrounding air on stopping the dynamo after a run of 10 consecutive hours with any load not exceeding 48 k-w.

Brush holders are to be provided with means for adjusting the tension of brushes on the commutator while the machine is in operation and to have insulating handles to the set-screws which hold the brushes and to the tension adjustment and such parts as may require to be handled in setting and adjusting the brushes.

Each dynamo is to be fitted with a terminal board conveniently located on the machine, on which board shall be placed the lamp circuit terminals, separate terminals for field and armature, and such other terminals as are used with the machine. Each terminal is to have a locking nut or similar device to make secure the cable connection, and on board shall be placed a hand switch, by means of which the generation of current can be stopped or started while the dynamo is in motion without strain on the machine or risk to the operator, the connections of such switch to be such that in its final position after stopping the generation of the current, it will short-circuit the main terminals of the dynamo.

The dynamos shall be delivered in running order, ready for connection to circuit and motive power, and in position on the commission's engine-room floor or foundation.

The contractor will guarantee each dynamo furnished to be fit for operation daily for 18 hours per day at its rated output, or any less output, and at normal speed, and to be fit for operation for 10 consecutive hours at a speed of 10% above the normal, with output of 9 6-10 amperes at 5,500 volts; to be free from defect of material, and to be perfect in workmanship; to be fit to withstand without injury the more common accidents of operation, such as the sudden breaking of the circuit when operating at rated output, or the sudden short-circulting of the lamp circuit when operating at rated output, and the continuance of such short-circuit for five minutes without any attention being given to the machine. He will further undertake to replace, free of charge, each armature, or each field coil, which may burn out or may otherwise become defective in any manner or from any cause within one year after the acceptance by the commission of the dynamo of which such armature or such field coil forms part, unless it shall appear to the commission beyond question that the defect is due to fault of the commission's employees. And he will agree to remove at once from the premises of the commission any dynamo which the commission may refuse to accept as not in accordance with specifications, notice of such refusal being given to him or to his representative within 90 days after he shall have delivered the dynamo.

Before acceptance of any dynamo by the commission it will be operated on regular work by the commission's employees for 90 days, during which time, in addition to the regular work of the lighting plant, the dynamo will be subjected to such examination and tests as may be considered by the commission necessary to determine that it conforms to specifications and to the guarantees made by the contractor. The contractor, or his representative will have free access to the dynamo during the 90 days, but is not to control or interfere with the operation or tests. Whether any dynamo does or does not conform to the specifications and to the guarantees made by the contractor shall be solely and finally determined by the commission.

Engines and Dynamos Direct-Coupled.—The commission invites bids on 18 direct-coupled engines and dynamos, and will receive and consider the same along with the bids on vertical engines adapted to drive dynamos by belt and dynamos adapted thereto, called for in the preceding specifications. Bidders on direct-coupled machinery are requested to study carefully the said specifications, that they may understand with what manner of machinery they are in competition and they will be guided by them in such matters as are not differently specified hereinafter.

The dynamos to be of direct current type, with constant current of 9 6-10 amperes and varying voltage to operate arc lights in series. The engine to be either compound or triple expansion, condensing, either vertical or horizontal, the arrangements of cranks and cylinders being left to bidders.

The output to be not less than 48 nor more than 50 k-w., the power of the engine to be such that the best steam economy will be obtained within the limits of 36 k-w. as a minimum and 48 k-w. as a maximum output. Steam pressure is to be such as bidder may propose within the limits of 125 and 160 lbs. above atmosphere and the vacuum, 26 ins.

Bidders are invited to guarantee combined efficiency within the limits of output stated in preceding paragraph. They are further requested to note that the output at which the dynamo will be most commonly operated will be approximately 41 k-w. and are invited to guarantee the efficiency at that point. Each bidder will specify the speed which best suits his apparatus.

The regulation is to be by moving the steam distributing valves of the engine according to the varying load, whether the speed is to be held constant or is to vary with the output. Automatic control of the valves, either by constant speed governor or by a device responding to variation of current, is preferred; but (inasmuch as the machines are to be operated on normally constant load) a steam throttle under automatic control will be considered, provided a convenient device for the adjustment of the distributing valves by hand while the machine is running is also furnished, and provided the throttle will cause no obstruction to the free flow of steam when it is not required to be in action, and has an indicating device to show when it goes into and comes out of action. A manner of regulation which makes the current control the supply of steam directly will be preferred, other things being equal, rather than that which secures a constant speed of the engine and governs the dynamo separately. The attention of the bidders who are builders of engines exclusively is called to the fact that a dynamo of the constant-current type, as commonly used for arc lighting, need not be driven with constant speed under varying load, but that the speed may be reduced as the load falls off, and that if this reduction of speed is proportional, no further regulation is necessary nor is any readjustment of

the brushes required. Constancy of current within the limits specified for belt-driven dynamos is required. An insulating coupling between the engine and dynamo is required. Its insulating surfaces must be large, smooth and readily accessible for wiping in order that they may be kept free from oil or moisture. A good thickness of material mechanically strong and of fairly high specific resistance is desired, rather than insulating parts mechanically weak, though of very high specific resistance. The frame of the dynamo must be likewise insulated from the common base frame.

The lubrication must be specially adapted to high rotative speed and long, continuous running. Positive lubrication by pump or spray is preferred. Emergency lubricators arranged to flood the main bearings in the event of heating are required in addition to the means provided for regular running.

Arc Lamps—Number.—There will be required 1,500 direct current arc lamps, to be operated in series, double service, for outdoors. Volts at arc to be 46, when the lamp is supplied with a constant current of 9 6-10 amperes. Bidders will state the terminal volts, and the watts expended otherwise than in the arc of the lamp they offer, under these conditions.

The arc must assume its normal voltage within 10 seconds after the current is turned onto the lamp and be maintained within one volt of the normal continuously thereafter during the burning of the lamp, excepting only the instant during which the feed takes place, when a drop of four volts below normal, if regained immediately, will be allowed. Contractor may furnish special carbons for the test of regulation and readjust the lamps to be tested so as to give proper voltage at arc with these special carbons, if he so wishes, but the adjustment of the lamps for use is to be with the commercial carbons commonly used by the contractor.

The feed will be either by clutch or by brake. A clock-train, or step-by-step movement of feed mechanism will not be accepted, but a single rack and pinion movement, with correctly cut teeth, may be used in connection with brake feed.

The mechanism must be of the best material and workmanship, contain the least possible number of springs, and not so placed or connected as to be heated by the current or by heat conducted or radiated from the arc. It must contain no dashpots or contacts requiring the use of liquids and generally be of simple and strong construction. A lamp having a multiplicity of moving parts, or having a mechanism subject to wear at many points, will not be considered. Nor will a lamp be considered which has a mechanism difficult to dismount and reassemble or requiring special appliances for its repair.

The lamp must stand "cut-out" when no current is on the circuit, whether trimmed or not, and must remain cut-out without motion of any part if the current is turned on before it is trimmed. This standing cut-out is to be operated by gravity or other means in no way dependent on the trimmer or on the current. The cut-out circuit is to be of as low resistance as possible and the cut-out contact is to be guaranteed to be self-cleaning and fit to carry twice the working current for 18 hours without deterioration. An additional automatic and self-releasing cut-out which will protect the shunt circuit from injury by excessive current if the main circuit of the lamp should be suddenly broken is also required, unless the main cut-out performs this function. And the lamp must cut-out effectively when the carbons are consumed and continue so thereafter until retrimmed.

The service will be 15 hours' continuous burning outdoors with one trimming of ordinary molded carbons, copper-coated, costing in market not over $27 for 1,000 15-hour sets.

The lamp will be run in circuits of 80 to 100, and the insulation of the lamp from its case should be designed with this fact in view. A closed style of case is called for in another part of these specifications. No part of the case must be in circuit nor may any conducting part be exposed to touch when the case is closed. Insulating parts throughout must be of material non-absorbent of moisture, and non-combustible and of material not affected by variation of temperature. Parts exposed to carbon dust, as the insulations of the negative carbon holder, must be so arranged that the dust cannot form a conducting path over the insulations. The binding posts must be completely covered and accessible only by opening the case, connection being made to them by insulated cables entering through tight nipples. Two rubber insulated and braided cables sufficiently long to reach 1 ft. above the top of the lamp chimney are to be fitted to each lamp.

A closed lamp case is required, ventilated so as to allow free passage of air from the bottom upward, but having the ventilating openings screened against rain or sleet and covered with metal gauze to exclude insects. The case must be arranged to allow quick trimming of the lamp and ready removal of the globe for cleaning. The case as a whole must be storm-proof and fit for use without hood or any external protection. Design of case to be approved by the commission.

There will be required 2,000 globes to fit the lamps, of shape and size to be selected by the commission. They will be of clear glass, except 250, which may be half-ground, or full-ground as the commission may select; 2,000 globe nets of brass or copper wire, to fit the globes, are required.

There are required 1,250 combined switches and hangers for arc lamps, each to contain in a watertight and airtight metallic case an absolute cut-off switch that when turned into the "off" position will effectively close the circuit and at the same time completely disconnect the lamp, and that will reconnect the lamp when turned into the "on" position, performing both operations without spark or flash. The handle of the switch to be thoroughly insulated from the circuit and brought out through an airtight stuffing box. The case is to be fitted with an insulated hook or hooks by which the lamp can be suspended, so arranged that the lamp after being switched off can be readily and safely removed from the suspension and disconnected from the switch box. The cables to and from the switch are to enter and leave the case through tight nipples. The case is to have separate insulated hooks and shackles whereby it may be suspended from a mast-arm or similar device. Sample or plan of case and switch to be submitted with bid.

There are required 250 switches for use inside of iron lamp posts connected with underground cables. These are to be the same as the combined switch and hanger, except that no insulated suspension hooks are required, and lugs to secure the case inside the post must be supplied instead, and that the nipples at which the cables enter and leave the case are to be fitted with union joints adapted to make water and airtight metallic joint between the metal of case and the lead cover of the cables.

Ten thousand sets of carbons for 15 hours' service are required, to be of the kind and quality which the contractor usually furnishes for use with lamps.

Each bidder will send to the office of the commission, with or in advance of his bid, a sample of the lamp he proposes to furnish. He may send drawings only of the case and globe, if the sample differs in these respects, but the mechanism and all working parts of the sample are to be exact.

The lamps will be at the power house of the commission.

The contractor will guarantee each lamp furnished by him to be free from defect of material and to be perfect in workmanship and to be in all respects in accordance with specifications and in accordance with the statements made by him or in writing accompanying same.

No lamp will be accepted until it shall have been operated on the circuits of the Commission for 90 days, said 90 days to begin not later than 10 days after delivery of the lamp. The Commission will, during the trial period of 90 days, subject each lamp or as many lamps as it may consider proper, to tests and examinations in order to determine that it conforms to specifications and to the contractor's guarantees. During the period of 90 days the contractor, or his representative, will have free access to the lamps, but he is not to control or interfere with the operation or tests. Whether any lamp does or does not conform to the specifications and to the guarantees made by the contractor shall be solely and finally determined by the Commission.

The public lighting commission has recommended that contracts for the various parts of the plant be awarded as follows: Engines, five triple expansion, Saml. F. Hodge & Co., Detroit, $20,000, equivalent to $13.56 per horse power, rating the engines at 295 HP. each; $1,625 would be deducted if pulleys were omitted. Boilers, seven Peck double-deck, with Hawley down draft furnaces, to Chas. A. Strelinger & Co., Detroit, $31,500, equivalent to $14.77 per nominal horse power. Dynamos, 18; 100 arc light, 500 revs. per minute, Western Electric Co., Chicago, $41,250, or $22.90 per 440-watt arc light supplied. Double carbon lamps, 1,500, including 10,000 sets of 15-hour service carbons, Brush Electric Co., Cleveland, $41,969, or $27.97 per lamp.

The following are the detailed bids received:

5 Triple Expansion Engines, 295 HP. each.

A. Harvey Sons Mfg. Co., Detroit, extra finished, $37,500; plain finished, $34,000.
Samuel F. Hodge & Co., Detroit, $20,000.
McIntosh, Seymour & Co., Auburn, N. Y., $36,000.
Nordberg Manufacturing Co., Milwaukee, Wis., $35,400.
Frontier Iron Works, Detroit, $32,460.
Ranken & Fritsch Foundry & Machine Co., St. Louis, Mo., $25,075.
Ball Engine Co., Erie, Pa., exhibit "A," $33,860; exhibit "B," $32,175.

5 Compound Engines, 295 HP. each.

Ball Engine Co., Erie, Pa., exhibit "F," $23,500; exhibit "G," $25,000.
Fairbanks, Morse & Co., Chicago, Ill., Fitchburg, automatic, $28,750.
Ranken & Fritsch Foundry & Machine Co., St. Louis, Mo., $21,950.
Frontier Iron Works, Detroit, $27,210.
Stearns Manufacturing Co., Erie, Pa., $19,000.
Samuel F. Hodge & Co., Detroit, $17,000.
McIntosh, Seymour & Co., Auburn, N. Y., $28,000.
A. Harvey's Sons Mfg. Co., Detroit, extra finished, $33,500; plain finished, $29,000.

7 Boilers, 300 HP. each.

A. Harvey's Sons Mfg. Co., Detroit, Root water tube, plain grate, $31,958; McClave grate, $34,583; Hawley down draft furnace, $38,958; steel tubular shaking grates, $19,475.
National Water Tube Boiler Co., New Brunswick, N. J., National water tube, rocking grates, $28,378; Murphy furnace, $33,643; Hawley down draft furnace, $34,562.
The Stirling Co., Chicago, Ill., Stirling water tube shaking grates, $20,500; Jones' underfeed furnace, $38,500; Hawley down draft furnace, $37,800.
Link Belt Machinery Co., Chicago, Ill., Standard water tube, flat grate, $23,900; Hawley down draft furnace, $32,650.
Campbell & Zell Co., Baltimore, Md., Zell water tube, shaking grates, $35,000; Roney stoker, $42,000; Jogada furnace, $43,500; Hawley down draft furnace, $41,500.
Wickes Bros., Saginaw, Mich., Wood water tube, rocking grates, $32,700; Murphy furnace, $41,208; Jogada furnace, $42,310; Hawley down draft furnace, $39,060.
Chas. A. Strelinger & Co., Detroit, Peck double deck, Hawley down draft furnace, $31,500.
Babcock & Wilcox Co., Chicago, Ill., B. & W. water tube, common grate, $37,624; Culver-Corliss rocking grate, $39,774; Roney furnace, $43,949; Jones underfeed, $45,874; automatic chain grate, $45,149; Hawley down draft, $44,149 (bid No. 2), common grate, $35,930; Culver-Corliss rocking grate, $37,880; Roney furnace, $42,380; Jones' underfeed, $44,180; automatic chain grate, $43,480; Hawley down draft furnace, $42,480.
Murphy stoker, $7,956, with Babcock & Wilcox, Zell, National, Root, Gill or Heine boilers, $7,848 with Wood or Stirling boilers.

18 Dynamos, 50 K-W. Each.

Excelsior Electric Co., New York, 475 rev. per min., $53,100.
Standard Electric Co., Chicago, 475 revs. per min., $46,800.
Brush Electric Co., Cleveland, 500 revs. per min., $43,000.
Western Electric Co., Chicago, 300 revs. per min., $47,500; 450 revs. per min., $44,800; 500 revs. per min., $41,250.

1,500 Double Carbon Lamps.

Excelsior Electric Co., New York, $60,000.
Western Electric Co., Chicago, Ill., $43,000.
Brush Electric Co., Cleveland, O., $41,969.

1,500 Single Carbon Lamps.

Western Electric Co., Chicago, Ill., $35,500.
Standard Electric Co., Chicago, Ill., $34,570.
Peninsular Electric & Engineering Co., Detroit, $29,775.

Direct-Connected Apparatus, 18 sets, 50 K-W. Each.

Fisher Electrical Manufacturing Co., Detroit, twin compound engines, $106,560; vertical tandem compound, $97,020; horizontal tandem compound, $92,520.
Standard Electric Co., Chicago, compound non-condensing engines, $89,925; compound condensing, 99,528; triple expansion, $106,072.
Brush Electric Co., Cleveland, compound non-condensing engines, $85,100; compound condensing, $94,500; triple expansion, $104,975.
Western Electric Co., Chicago, compound non-condensing engines, $89,925; compound condensing, $99,500; triple expansion, $104,975.

PERSONALS.

Mr. George A. Carpenter has been appointed City Engineer of Pawtucket, R. I.

Mr. Don F. Milne has been made Superintendent of the Toledo, St. Louis & Kansas City Ry., vice Mr. Edward Dresser, resigned.

Mr. E. A. Porter has been appointed General Manager of the Chicago, Fort Madison & Des Moines Ry., vice Mr. J. C. Mackinnon, resigned.

Mr. Frank P. Johnson has been reappointed as City Engineer of Waltham, Mass., and will also have charge of sewers, the Sewer Commission having been abolished.

Mr. Dewitt C. Smith, City Engineer of Schenectady, N. Y., has been appointed Resident Engineer of the Eastern Division of the Erie Canal, to succeed Mr. Jay W. Clark.

Mr. Chas. R. Bettes, Assoc. M. Am. Soc. C. E., has been appointed Engineer-in-Charge of the Queens County Water Co., resident at Far Rockaway, L. I., vice Mr. F. S. Pecke, resigned.

Mr. Rudolph Hering sails for Europe this week as a delegate from the American Society of Civil Engineers to the International Congress of Medicine, to be held in Rome about April 1.

Mr. R. B. Hughes, of Rapid City, has been appointed Surveyor-General of South Dakota, with office at Huron. Mr. Oscar Ricker, City Surveyor of Rapid City, will be Chief Clerk under Mr. Hughes.

Mr. J. A. L. Waddell, of Kansas City, Mo., has been appointed Chief Engineer of the Jefferson City Bridge & Transit Co., which proposes to build a highway and electric railway bridge over the Missouri River at Jefferson City, Mo.

Mr. James Dun, Chief Engineer of the Atchison, Topeka & Santa Fe R. R., has had his jurisdiction extended over the Colorado Midland Division, vice Mr. B. H. Bryant, who will continue to discharge the duties of Superintendent.

Mr. Willard Young has been appointed City Engineer of Salt Lake City, Utah, vice Mr. A. F. Doremus, re-

signed, and Mr. Doremus has been appointed President of the Board of Public Works, vice Mr. C. L. Haines, whose term has expired.

Mr. Geo. E. Thomas, who has been engaged as superintendent of construction with Sooysmith & Co. for the past 16 years, has resigned his position and entered into partnership with Mr. W. B. Hayes as general engineers and contractors, with headquarters at Chicago, Ill.

Count Ferdinand de Lesseps was, on Feb. 13, made Honorary President of the Suez Canal Co. by the Paris directors. M. Guichard, formerly Vice-President, was made President. MM. Charles and Victor de Lesseps have resigned from the managing committee and directory.

Mr. John Galloway, a well known mechanical engineer and head of the large engine and boiler building firm of Messrs. Galloway, Manchester, England, died recently, at the age of 89. He was associated with Sir Henry Bessemer in the establishment of the first steel plants for the Bessemer process. He made a specialty of mill machinery.

Mr. Frederick Law Olmstead has been engaged as consulting engineer for the Brooklyn Parks, vice Col. John Y. Culyer, whose office of constructing engineer has been abolished by the new Park Commissioner, Mr. Frank Squier. Mr. Olmstead was one of the original designers of Prospect Park, and is famous for his work in laying out Central Park and the Exposition grounds at Chicago.

Mr. Spruille Braden, mining engineer, of Helena, Mont., died in Washington, D. C., Feb. 25. He was on his way home from the annual convention of the American Institute of Mining Engineers, and the exertion of walking through the heavy snowstorm in Washington on Sunday night to visit a friend brought on heart failure. He was at one time Superintendent of the Assay Office at Boise City, Idaho, and later of the assay office at Helena, Mont. Since then he has been in practice as a mining engineer, and he had just returned from a trip to England in connection with the development of goldfields in South Africa.

Prof. Edwin J. Houston, President of the American Institute of Electrical Engineers, and Mr. A. E. Kennelly, one of the vice-presidents of that society, have formed a partnership as consulting electrical engineers, with headquarters in Philadelphia. Mr. Kennelly has for six years past been the chief electrician of Mr. Edison's experimental laboratory, and Professor Houston's name has become famous both for his scientific work and for his inventions, which formed the basis on which the original Thomson-Houston Co. was organized.

NEW PUBLICATIONS.

ENGLISH METHODS OF STREET RAILWAY TRACK CONSTRUCTION.—By James More and Alex. McCallum. New York: Street Railway Publishing Co.; 8vo; pp. 26; illustrated; 35 cts.

This pamphlet is devoted to a consideration of girder rail construction, and describes different arrangements of girder rails attached to steel crossties or longitudinals bedded in concrete or resting directly on the concrete base, which is only practiced with heavy rails, 5 to 7 ins. wide over the base, and good Portland cement concrete. For switches cast steel (annealed) is preferred to chilled iron, as although softer it is tougher and not liable to fracture, but switches built up of rails are considered more durable than either of the others. Kincaid's switch has a vertical rocking or tilting movement. The concrete should be at least 6 ins. deep, and may be made of washed and screened old macadam and Portland cement, 6 to 1, or 4 of broken stone, 2 of sand and 1 of cement. The English cable system, with cast iron yokes, and with the track rails resting on concrete and tied to the slot rails for gage is considered superior to the use of yokes carrying the slot and track rails, as the latter is more expensive, requires a deeper conduit, and there is greater vibration. As to electric traction, the authors consider that economical secondary batteries and low-speed motors to work at eight miles an hour or less, with frequent stoppages, is the ideal application for England.

METROPOLITAN SEWERAGE COMMISSIONERS OF MASSACHUSETTS.—Report for the Year Ending Sept. 30, 1893. Howard A. Carson, Chief Engineer. Paper; pp. 134; many tables and illustrations.

This report reviews in detail the work done in 1892-3 on a trunk sewer system for a part of Boston and a large number of its suburbs. The large folding map in the report was reproduced as an inset sheet in our issue of Jan. 25, 1894; and in our issue of Feb. 8, 1894, another inset sheet was published showing a large number of sewer cross-sections employed throughout the work. In both of the above-named issues there appeared articles describing the work.

ANNUAL REPORTS.—The following water-works reports have been received, the names given being those of superintendents, unless otherwise specified:

Fall River, Mass., P. Kieran; Middleboro, Mass., Jos. E. Beals; Northampton, Mass., Luther C. Wright; Pawtucket, R. I., Edwin Darling; Waterbury, Conn., Welton & Bonnett, Engineers; Hudson, N. Y., C. Wurster; Norfolk, Va., for the years 1891-2 and 1892-3, H. L. Smith; Battle Creek, Mich., W. W. Brigden.

The following city engineers' or other municipal reports have been received, the reports and names being those of city engineers, unless otherwise specified:

Pawtucket, R. I., Sewer Commissioners, A. R. Sweet, Engineer; Rockrord, Ill., City Officers, C. C. Stowell; Albany, N. Y., Horace Andrews; Keene, N. H., Water and Sewer Departments, Paul F. Babbidge, Superintendent; Rochester, N. Y., Executive Board, Geo. W. Aldridge, Chairman; Roanoke, Va., City Reports, Clarence Coleman, Member Board Public Works.

TRADE PUBLICATIONS.

STEAM, WATER AND GAS SUPPLIES.—Smith & Winchester's Illustrated Catalogue of Steam, Water and Plumbing Supplies, Wind Engines, Pumps, Artesian Wells, Tools, etc. Smith & Winchester, 19 Wendell St., Boston. 4to; pp. 784; 2,294 illustrations and many tables.

Some of the most expensive new books in these days of numerous and costly publications are trade catalogues, many of which rank high in their relative value with other volumes in an engineers' or contractors' library. As may be seen from the statement from the number of pages and cuts given above, the supply catalogue under notice is a large, and must have been an expensive one, while an examination of its contents shows it to be a valuable reference book for those who purchase these classes of supplies or wish to know their prices. In addition many engineers and contractors may learn from this catalogue what supplies are available for use in certain cases, and may glean much information regarding weights, dimensions, shapes and other essential points in designing and estimating.

Of the 2,300 illustrations attention may be called to a number of good views of windmills supported on towers of pleasing design, and also to some handsome wrought iron fence and gate work.

THE SHERMAN AERIAL HOISTING AND CARRYING APPARATUS.—C. B. Johnson, Manager, 85 Ninth St., Brooklyn, N. Y. Pamph.; 4to; pp. 26.

This pamphlet is devoted chiefly to a reprint of the illustrated description of this new system of hoisting and transferring material which was published in Engineering News of May 18, 1893.

SOCIETY PROCEEDINGS.

ENGINEERS' CLUB OF ST. LOUIS, Meeting of Feb. 21, President Crosby in the chair; 28 members and visitors present. A special committee reported upon the subject of boulevards in the center of the city, but delayed action until a larger committee of 50, representatives of the city exchanges and certain clubs agreed upon a plan. Mr. John Dean read a paper upon the Manchester Ship Canal, which was discussed.

Wm. H. Bryan, Secy.

NORTHWEST RAILWAY CLUB.—At a meeting on Feb. 13 papers were read by Mr. Geo. Dickson, of the Great Northern Ry., and Mr. H. L. Preston, of the Chicago, St. Paul, Minneapolis & Omaha Ry., on "Steel vs. Iron for Locomotive Car Axles." Mr. Dickson's paper gave the record of certain axles which had been in use on the Great Northern Ry., which offered a fair basis for comparison, which resulted somewhat in favor of the steel axles, both for safety, convenience and cost. In the discussion Mr. L. R. Pomeroy took the position that an alteration of the structure of iron, bringing about a condition similar, if not exactly coresponding to crystallization can be brought about by vibration, and gave examples of crane chains and spokes of certain wrought spoke wheels to illustrate his position. The question of the best material for piston rods was also discussed.

The subjects for the next meeting, on March 13, will be "Brick Arches in Fireboxes" and "Care of Passenger Trains at Terminals."

C. A. Seley, Secy.

ENGINEERS' CLUB OF PHILADELPHIA.—Meeting of Feb. 17, President John C. Trautwine, Jr., in the chair; 53 members and visitors present. Mr. W. B. Riegner presented a paper on "The New Falls of Schuylkill Bridge of the Philadelphia & Reading Railroad Company," built to provide direct connection for trains running between Wayne Junction and the junction of the Reading and Baltimore & Ohio roads at Girard Ave. station. The bridge consists of an 80-ft. stone arch over the East Park Drive, and eight deck plate girder spans, one of 60 ft., one of 92 ft., and six of 87 ft., c. to c. of piers, over the river and adjacent low ground and the West Park Drive. It carries two tracks, 13 ft. c. to c. The alinement is a 6° curve, and the gradient is .25%, rising to the eastward. The bridge was illustrated and described in Engineering News Jan. 24, 1891.

Mr. John C. Trautwine, Jr., called the attention of the meeting to an interesting hydraulic problem which occurred in supplying the village of Frackville from the Mud Run reservoir, in Schuylkill County. The water was fed through a 10-in. pipe, for a distance of 8,000 ft., to locomotives and fire-plugs in the village. The fall in the pipe was 40 ft., and the head in the reservoir 20 ft. At the village, this pipe separated into two branches 6 ins. in diameter, one, 3,200 ft. long, running to the village of Mahanoy Plain, with a fall of 340 ft., and the other about 1,500 ft. long, running to the headhouse of the plain, and in this distance first rising 2 ft., then falling about 10 ft. to the upper story of the headhouse, and 15 ft. further to the cellar. The difficulty experienced was, that owing to the much greater head in the long pipe, the valley at its end got all the water, leaving practically none for the headhouse at the top of the plain. Mr. H. K. Nichols, Chief Engineer of the Philadelphia & Reading Railroad, remedied the trouble by the simple expedient of introducing in the long pipe, just below the branch, a siphon about 18½ ft. high, provided at the top with a blow-off cock, by which the air is allowed to escape when it accumulates in too great quantities. A memorial of the late Joseph D. Potts was presented by a committee, the substance of which has already been given in the personal columns of this journal.

L. F. Rondinella, Secy.

AMERICAN INSTITUTE OF MINING ENGINEERS.—The annual meeting was held at the Princess Anne Hotel, Virginia Beach, Va., on Feb. 20 to 23. A large party arrived at Norfolk on the morning of Feb. 20 by the Bay Line steamer, and at a meeting in the New Atlantic Hotel speeches of welcome were made by the mayor, Mr. A. B. Cooke, Hon. Barton Myers, Gen. E. M. Henry, president of the Business Men's Association, and M. A. Myers, of the Real Estate Exchange. These addresses were responded to by Mr. H. M. Howe, President of the Institute, and Major Hotchkiss, geologist and engineer of the Flat Top Coal & Land Association. After a carriage ride about the city the party left for Virginia Beach by a special train on the Norfolk, Albemarle & Atlantic Ry. at 12:30 p. m. At the first session of the meeting, held in the evening, the secretary, Dr. R. W. Raymond, gave an interesting lecture on the mining exhibits at the World's Columbian Exposition, the lecture being illustrated by steropticon views. There were also addresses of welcome by Mr. John R. Graham, representing the local committee, and others, which were replied to by Mr. H. M. Howe, president.

On Wednesday, Feb. 21, the party went to Norfolk in the morning, and took the steamer "Luray" for a day's excursion about the great landlocked harbor formed by Hampton Roads and the James and Elizabeth rivers. The first stop made was at Lambert's Point, to inspect the iron coal pier and tipple of the Norfolk & Western R. R., one of the interesting features of which is the automatic transfer table which transfers the unloaded cars to the gravity return track. The table is pivoted at the back end, and the front end is carried on wheels on an inclined track. The weight of the car causes the free end of the table to run down until its track coincides with that of the gravity track, and as soon as the car is off a counterweight returns the table to its loading position. As the cars are not all of the same weight a brake attachment is used to regulate the working of the table. From there the steamer proceeded to Newport News, visiting the extensive works of the Newport News Shipbuilding & Engineering Co., which were described in our issue of May 16, 1891. In the drydock was the steamer "New York," of the American Line, being overhauled for the coming season, and some drilling work on the plating was being done by portable electric motors and Stow flexible shafts (Eng. News, June 1, 1893). These works have a contract for three gunboats for the U. S. Navy. The Chesapeake & Ohio Ry. has extensive piers here, a coal tipple and a very large elevator having carriers running along over one of the piers and fitted with chutes to discharge the grain into the hatchways of vessels lying alongside the pier. The company will also establish large freight terminals at Norfolk. The party took lunch at the Hotel Warwick, and brief addresses were made by Mr. Horace See, Constructing Engineer for the Newport News Shipbuilding & Engineering Co., and by Mr. Howe, President of the Institute. The steamer then proceeded to Hampton, where the party visited the Hampton Institute for the education and manual training of Indian and negro boys and girls, and then went on to Old Point Comfort, where the party went to Fortress Monroe to see the drill of the battalion stationed at that post. The party then returned to Norfolk and took a special train back to Virginia Beach.

At the evening session Capt. W. H. Jaques, Ordnance Engineer for the Bethlehem Iron Co., presented an interesting paper on "The Manufacture and Testing of Guns and Armor," which was similar to a paper read by him before the American Society of Civil Engineers and other societies, and was profusely illustrated by stereopticon views.

At the morning session on Feb. 22 the first paper

read was by Prof. R. H. Richards, of Boston, Mass., on "Close Sizing Before Jigging." He described a pointed tube apparatus into which the material is fed while an upward current of water agitates it sufficiently to allow the particles to arrange themselves closely as to size, the heavier particles at the bottom and the lighter at the top. The material can then be drawn off gradually by a bulb at the bottom of the tube, and the contents of each bulb passed through sieves for sizing it. Dr. Becker then read a paper on "Torsional Theory of Joints," referring to faulting being caused in many cases by a torsional movement rather than by a direct parallel sliding movement. This is not generally recognized in this country, but in France is so generally observed that such faults are termed by the miners "hinge faults." Mr. C. R. Boyd then read a paper on "Correlations in the Coal Rocks West of Pocahontas, Flat Top, Virginia," which was followed by one by Major Hotchkiss on "The Flat Top Coal Field and Its Extensions in the Light of a Decade of Development." This field produces the Pocahontas coal now being extensively used for ocean steamers, and found satisfactory in the trial trips of vessels for the U. S. Navy and for the fast runs of such vessels as the "Campania," of the Cunard Line. The Flat Top Coal & Land Association owns 200,000 acres of land covering this coal field, and there are now 38 mines open along the line of the Norfolk & Western R. R. After some discussion as to the relative merits of Pocahontas and Nova Scotia steam coal the meeting adjourned.

At the afternoon session Mr. A. W. Sheafer read some "Notes on the Reworking of Anthracite Culm Banks," showing that there is a considerable amount of culm too valuable to waste on the site of every old or present colliery, while the rapid increase in the number of washeries and the demand for leases on old culm banks show that, in the Schuylkill region at least, the question of deterioration does not play an important part. The paper gave tables showing the percentage of coal of market sizes obtained from some of these banks, the sizes including stove, chestnut, pea and buckwheat. The culm smaller than buckwheat is now allowed to waste on account of the limited demand, but in the near future this will also probably be utilized for fuel. The presence of so much coal of present marketable sizes is due largely to the fact that these sizes were not marketable at the time when the banks were made. Dr. Raymond referred to the proposed system of sluicing back the waste from the surface to fill old workings, and also to the use of these culm banks in the manufacture of artificial fuel. Mr. Platt stated that very old culm banks do not have an appreciable amount of coal, as coal breakers were not introduced until 1855. Between 1875 and 1885 the Delaware & Hudson R. R. operated a plant for making artificial fuel bricks, but the introduction of the Wootten firebox for burning the small anthracite caused this process to be abandoned. Mr. Tratman referred to the utilization of small waste coal in the manufacture of artificial fuel. Coal briquettes are largely used in Europe for locomotive fuel and consist of fine coal mixed with a bituminous binder or cementing medium, while in England some very satisfactory results with fuel of this kind have been reported. In this country the Fuel Patents Co. is introducing "eggette" coal, which is made from crushed anthracite culm or lignite, mixed with a hot binder, the mass being then pressed between rolls having egg-shaped indentations or pockets, so that the finished product is in the shape of lumps of fuel about the size of hens' eggs. The results are reported as being very satisfactory, and three or four plants are now in operation. Two papers on the bauxite deposits were then read, one by Dr. G. W. Hayes, on the "Geological Relations of the Southern Appalachian Bauxite Deposits" and the other on "The Bauxites; a Study of a New Mineralogical Family," by Francis Laur, of France, translated by Dr. Raymond. These deposits are usually in the form of pockets, and their great importance is due to the fact that from them is obtained aluminum, which though practically a new metal, is rapidly coming into use in various ways. Mr. A. E. Hunt stated that in this country there are vast quantities of bauxite having no silica or oxide of iron. He exhibited a bauxite brick for refractory purposes, which is to be used in aluminum reduction for which the ordinary firebrick is not available owing to its containing silica.

Some notes on "The Artesian Waters of Eastern Pennsylvania and Maryland" were then read by Mr. N. H. Darton, in which he referred to the water bearing strata which slope downward toward the coast from about 70 to 80 miles inland. Several wells have been sunk, with more or less success, and Mr. Hotchkiss thought the War Department ought to sink a new and deeper well at Fort Monroe, as the one sunk with old-fashioned machinery some years ago did not prove satisfactory. Mr. Sahlin stated that the water for the steam and hydraulic plant of the Maryland Steel Co., at Sparrows Point, Md., is supplied by twelve 4 and 6-in. wells 180 ft. deep, the flow of which has been increased by putting down a pipe and pumping in a current of compressed air at a pressure of 80 lbs. per sq. in. The town of Sparrows Point, with a population of about 4,000, is supplied from wells 125 ft. deep. A brief discussion on "The Physics of Steel" then followed. Mr. Hibbard considered that the best practice in casting is to cast the ingots as small, as cold and as slowly as practicable. Capt. A. E. Hunt referred to the use of aluminum in casting to prevent segregation, enabling larger castings to be made than could be made without the mixture of aluminum. Mr. Hartshorne considered it more important to keep the impurities so low that when segregation does occur it will do no harm. Mr. Howe thought it would be well if we could insure that segregation would occur in a part of the ingot that can be thrown away.

In the evening the annual banquet was held, at which 125 members, ladies and guests, were present. Handsome souvenir spoons of aluminum bronze, tied with yellow and white ribbon (the colors of Virginia) were presented by Dr. Waldo, of the Waldo Foundry.

The final meeting was held on the morning of Feb. 23, at which the reports of the council and the treasurer were presented. The former showed a membership of 2,431, an increase of 55 since February, 1894. These are distributed as follows: Honorary members, 15; foreign members, 38; members, 2,206; associates, 174; total, 2,431. Dr. Leonard Waldo then gave some interesting notes on "Aluminum Bronze," showing what is being done and what they are trying to do in developing this alloy, which is a true chemical compound and not a mechanical mixture like brass. He exhibited fractured bars, and also specimens of large holding-down bolts for use in the mortar batteries for coast defense, where steel would be liable to corrosion. The metal is also used for cartridge cases. There is no evidence of segregation in the metal, and it is uniform throughout the ingot. The electrical conductivity is not yet definitely known, for the reason that the conductivity of aluminum has not yet been ascertained with any certainty. Specimens distributed had a tensile strength of 30,000 to 80,000 lbs. per sq. in. Mr. Platt referred to comparisons between Delta metal and aluminum bronze, and Captain Hunt stated that the Delta Metal Co., of France, has purchased the French patents of the Pittsburg Reduction Co., but Dr. Waldo did not consider that there was any relation between these alloys, the former being a mechanical alloy of copper and iron, and the latter a chemical alloy of copper and aluminum. The election of officers for the ensuing year was then announced as follows: President, John Fritz, Bethlehem, Pa.; Vice-Presidents, J. F. Holloway, New York, N. Y.; J. C. Platt, Waterford, N. Y., and E. V. D'Invilliers, Philadelphia, Pa. Managers, T. A. Rickard, Denver, Colo.; H. O. Hofman, Boston, Mass., and John A. Church, New York, N. Y.; Treasurer, T. D. Rand, Philadelphia, Pa.; Secretary, R. W. Raymond, New York, N. Y.

Besides the papers read and discussed a number were presented by title only, as follows: "Some Experiments for Determining the Refractoriness of Fire-Clays," H. O. Hofman and C. D. Demond; "Product and Economical Results of the Marsac Refinery for the Year 1892," C. A. Stetefeldt; "Unwatering a Flooded Mine," Beverley S. Randolph; "Ore Washer at Longdale, Va.," Guy R. Johnson; "Survey of Underground Connection at Leavenworth, Kan.," Edwin A. Sperry; "Refining of Gold Sulphides as Produced by Precipitation of Gold from Chlorine of Bromine Solution with Sulphurous Acid and Hydrogen Sulphide," Werner Langguth, Portland, Ore.; "The Cerro de Pasco Mining Industry," Otto F. Pfordte; "Benjamin Huntsman, of Sheffield, the Inventor of Crucible Steel," R. A. Hadfield; "Solids Falling in a Medium," F. M. F. Cazin; "Note on Certain Magnetic Phenomena in Gold-Bearing Slates," C. A. Mezger; "The Stetefeldt Furnace," C. A. Stetefeldt; "The Silver Mines of Lake Valley, New Mexico," Ellis Clark; "The Determination of Phosphorus in Coal and Coke," Jacob Lychenheim; "The Association and Genesis of the Zinc-Ore Deposits of Southeastern New Mexico," W. P. Blake; "The Deposit of Franklinite and Zinc-Ore at Mine Hill, New Jersey," Frank L. Nason; "Iron Ores of East Texas," William Kennedy; "Gold Milling at the North Star Mine, Grass Valley, Nevada County, Cal.," Emile R. Abadie; "Mine Explosions Generated by Grahamite Dust," William Glenn; "Coal Seam Sections Developed by Recent Operations in Wise County, Va., with Analyses of the Coals and Cokes," Franklin Bache; "Swedish Practice in the Manufacture of Open-Hearth Steel," Erik G. Odelstjerna; "A Convenient Still for the Laboratory," Prof. C. E. Wait.

In the afternoon a large party went by special train to Norfolk and thence by an Atlantic & Danville Ry. steamer to the navy yard at Portsmouth, where they were received by Admiral Brown, U. S. N., and a number of officers. Among the ships at the yard were the double-turreted monitor "Miantonomoh" and the dynamite cruiser "Vesuvius," both in commission; the cruiser "Raleigh," approaching completion; and the battleship "Texas," whose engines (built by the Richmond Locomotive Works) have already been given a dock trial, although work on the upper part of the hull is far from complete. The machine shops, sail loft, wood-working shops, etc., were visited, and also the drydocks, one of which has a 40-ton Sellers crane carried on three four-wheel trucks running on a track around three sides of the dock. The timber seasoning basins were also noted. The party then returned to Norfolk and by special train to Virginia Beach.

On Feb. 24 there was an excursion to the Dismal Swamp, which will long be remembered by those who took part in it. The day was very cold and there was a brisk snowstorm. From Norfolk a special train on the Norfolk & Western R. R. carried the party to Gilmerton, where the railway crosses the Dismal Swamp Canal by a plate girder double-track bridge, illustrated in our issue of Nov. 3, 1892. Here boats were taken, the ladies having a canvas covered steam launch while the gentlemen had a large cutter which was towed by the launch. Both boats were from the navy yard. At the first locks a naphtha launch with curtains took the place of the cutter, but in consequence of the cold the naphtha would not vaporize well and the wind blew out the flame of the furnace. After considerable delay the boat was started, but it was too late to go very far, so the party landed for a short walk into the swamp to see what it is like. On returning it was found that the engine again refused to work, and eventually some of the party got out and towed the launch in the teeth of a northeast wind. Later on the steam launch returned and picked up the party and carried them back to the locks, where an abundant lunch had been served in the lock-keeper's house. The water from the swamp is of a clear brown color, but is considered very healthy, and is especially desired for ships water tanks, as it does not ferment and get foul. Its color is removed by aeration. The return trip to Gilmerton was made in the cutter and steam launch, and after a long wait for the train, during which the party crowded the pump house of the water tank, the return to Norfolk was made, where the members separated, a large number going north on the Baltimore and Washington steamers.

COMING TECHNICAL MEETINGS.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
March 2. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
March 2. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS' CLUB OF PHILADELPHIA.
March 3. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
March 3. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 106 Randolph St., Chicago. Secy., C. T. Anderson.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
March 5. Secy., C. L. Arnan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHOENIXVILLE.
March 6 Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
March 7. Secy., J. W. Weston, Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
March 7. Secy., Wm. H. Bryan, Turner Bldg.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
March 7. Secy., F. Collingwood, 127 E. 23d St., New York
CANADIAN SOCIETY OF CIVIL ENGINEERS.
March 8. Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERING ASSOCIATION OF THE SOUTH.
March 8. "Coal Handling Plant at Pikeville, Tenn." Secy., Hunter McDonald, Nashville, Tenn.
ENGINEERS' AND ARCH'TS CLUB OF LOUISVILLE.
March 8. Secy., F. W. Mowbray, Norton Building.
MONTANA SOCIETY OF CIVIL ENGINEERS.
March 10. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
March 12. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
March 12. Secy., M. F. Schinke, City Hall, Milwaukee.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
March 13 Secy., F. C. Osborn, Case Library Building.
NORTHWEST RAILROAD CLUB.
March 13. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
March 13. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
DENVER SOCIETY OF CIVIL ENGINEERS.
March 13. Secy., F. E. King, Jacobson Block.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
March 14. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
March 14. Secy., F. M. Curtis, P. O. Box 1576, Boston.
AMERICAN SOC. OF MECHANICAL ENGINEERS.
March 14. Secy., F. R. Hutton, 12 W. 31st St., New York.
ENGINEERS' CLUB OF CINCINNATI.
March 15. J. F. Wilson, 24 W. 4th St.
NEW YORK RAILROAD CLUB.
March 15. Secy., John A. Hill, Temple Court.
SCANDINAVIAN ENGINEERING SOC. OF CHICAGO.
March 15. Secy., Howard Berge, 100 Washington St.
TACOMA SOC. OF ENGINEERS AND ARCHITECTS.
March 16. 201 Washington Building.
NORTHWESTERN TRACK AND BRIDGE ASSO'N.
March 16. Secy., D. W. Meeker, St. Paul.
ENGINEERS' CLUB OF MINNEAPOLIS.
March 19. Secy., E. Nexsen, 504 Kasota Block.
ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
March 20. Secy., R. H. Clark, Pittsburg.
WESTERN RAILWAY CLUB.
March 20. Secy., Clement F. Street, Rookery, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
March 20. Secy., F. W. Hart, Washington, D. C.
BOSTON SOCIETY OF CIVIL ENGINEERS.
March 21. Secy., S. E. Tinkham, 36 Bromfield St.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
March 21 Secy., J. A. Pilcher, Roanoke, Va.
CENTRAL RAILWAY CLUB.
March 28. Secy., S. W. Spear, Buffalo, N. Y.
AMERICAN RAILWAY ASSOCIATION.
April 11. Secy., W. F. Allen, 24 Park Place, New York.
SOUTHERN & SOUTHWESTERN RAILWAY CLUB.
April 19. Secy., S. A. Charpior, Macon, Ga.
MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago.
MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair, Temple Court, New York.

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Through the courtesy of the engineers in charge of the work, we are enabled to present this week complete illustrations and description of the tunnel under the East River, from Seventieth St., New York city, to Ravenswood, L. I., which is being built by the East River Gas Co. The scheme of this company is an interesting one. The high price of real estate in New York city, especially on its water front, would cause any company attempting to establish new works for gas manufacture here to be hampered with a very heavy investment in real estate at the start. The East River Co. secured a charter permitting it to lay mains in the streets of New York city, purchased a large tract of land as a site for its works at Ravenswood, L. I., opposite East Seventieth St., New York city, and set to work to drive a tunnel beneath the East River. In this tunnel when completed there will be laid two 36-in. and one 48-in. cast iron mains, to carry the gas from the holders at Ravenswood to the system of mains on Manhattan Island, the laying of which is to be vigorously prosecuted during the coming season.

This tunnel is of small diameter, not being intended for railway traffic, but with the exception of the incompleted Hudson River tunnel, it is the only submarine tunnel ever undertaken beneath the waterways that surround New York city. The experience gained in this tunnel is of especial interest in view of the proposed railway tunnel under the East River at Forty-second St., two miles lower down, by which freight and passengers were to be transferred from the Grand Central station to the terminus of the Long Island R. R., at Long Island city. It has been the general belief that the East River was underlaid by solid gneiss, in which a tunnel could be driven with safety, economy and dispatch, and it was on the supposition that only such material would be encountered that this railroad tunnel was projected. The experience gained in the East River Gas Co.'s tunnel proves that, at that point at least, considerable soft material underlies the river channels; and the uncertainties of possible soft ground tunneling must be considered in estimating the feasibility of any further tunnels which may be undertaken under the East River.

The proposed Virginia road law, elsewhere given in abstract, provides fairly well for an engineering organization under which roads may be classified and mapped, and general statistics may be gathered pertaining to the conditions of roads in the state, but in the bill as framed we see no attempt at the exercise of engineering authority over those who are actually to build the roads, bridges, etc. The county supervisors may, it is true, consult with the state, district or county engineers; but it is not required that they should either seek this professional advice, or follow it when given. The method of appointment is also objectionable, as the whole organization hinges on the will of the Governor of the State, and is practically upset every three years by the change in Governors. The county engineers, who are to receive the lowest pay, should really be the most useful and hard-worked men in the lot, if the system worked at all, and their usefulness should increase with the knowledge acquired by continuous service in their several districts. In fact, we see no necessity whatever for the three district engineers provided for in the bill, especially if each county should be furnished with copies of all maps and records relating to it, and if each has its county engineer.

The employment of engineers in the locating, construction and maintenance of public highways is to be heartily commended, and this work cannot be properly carried out without their assistance. But unless the engineers have full authority over the builders of the roads, bridges, etc., their advice, unbacked by this authority, is of little real value. There is a great deal of human nature in the average country road supervisor, and a corresponding lack of knowledge of what he ought and ought not to do in connection with road construction. With the best intentions in the world he will tend toward economy, as he understands economy, and ignore the advice of the engineer, when this is possible. After he has bought experience at the price of failure and wasteful expenditure, he may be more prone to accept advice; but this kind of education comes high to the ratepayers. Therefore, a good road law must provide an engineering guide equipped with full authority to enforce his advice; and while the country at large is not quite ready for such laws, they will come in time and all tentative legislation should tend in that direction. The proposed Virginia law, here referred to, would be good enough to carry out one of the first requirements in highway reformation in a state, and that is, the gathering of road and bridge statistics and their mapping, classification, etc. But this necessary preliminary work could be done cheaper and quite as efficiently by a special engineering commission appointed for this purpose; and this commission would do it really better because unhampered by the machinery of appointments and dismissals provided for in the proposed bill. When it comes to actual construction of roads, the county system, including the issue of county bonds expended under a competent county engineer, elected or appointed by the court, would seem to be best adapted to immediate needs, and may be supplemented by state engineers and state highways as the public becomes better educated to the needs of the case. In the present attempts at legislative action this system seems to be the favorite in both the older and the newer states of the Union.

In all the industrial arts, the United States has made a wonderful advance since the Centennial Exposition of 1876. Up to that date practically all that was artistic in the decoration of our homes was brought here from abroad; our architecture was of a mediocre type, with little, if anything, original in it, and our workshops were devoted to the manufacture and our shops to the sale of goods that were much more useful than beautiful. All this has changed in a remarkable degree, as any one using his eyes can see for himself. But we hardly expected so warm an acknowledgment of this artistic development as comes from M. Victor Champier, who was commissioned by the French Minister of Public Instruction and the Fine Arts to personally investigate and report upon the condition of the industrial arts and organization of art schools in the United States, in connection with the Columbian Exposition of 1893. M. Champier says that the progress already attained in some American art industries is "very ominous for the future of the French market," and that "in gold and silverware, in jewelry and in plate glass, the American artists have exhibited a real originality and a perfection of workmanship which are not exceeded by our best fabricants." He goes on to add to the list wallpaper, woodwork, furniture, artistic wrought iron and pottery, and remarks that novel and beautiful effects are produced in all these by the very ingenious processes invented by the Americans, and that they excel in all articles in which both hand labor and machinery are employed. He believes that, to retain the market for artistic products, so long held by French makers in this country, it is urgent that France make efforts commensurate with her American competitors; and unless this is done, he says the French will be distanced in more than one point in their next universal exposition of 1900. M. Champier presented to the Museum of the Sevres Manufactory, as being especially worthy of careful notice by Frenchmen, Rookwood pottery and Kaolin from Ohio, "as white and pure as that from Limoges."

The conclusions of M. Champier must be very gratifying to those interested in the art industries and art schools of the United States, for these conclusions are those of a selected and competent judge who issues them in the nature of a necessary warning to his own countrymen. It is true that much of the artistic work which won his praise is due to imported artists; but the art schools, upon which wealthy Americans have expended millions since 1876, are training and have put to work many competent artists of native birth. France has practically held the field against the world for many years in artistic products, and this hearty acknowledgment of the rapid development of American art industries by a French expert can hardly fail to inspire renewed efforts on the part of American artists and American makers of articles of ornament and luxury. We have unusual advantages in the abundance and variety of materials to work with; and a very marked advantage in the superiority of tools and processes and in the skill of our workmen.

The New Decimal Association, of London, is calling renewed attention to the necessity, on the part of English manufacturers, of using the decimal system in giving the dimensions and power of machinery intended for foreign markets. The absurdity is pointed out of issuing catalogues in French and other languages, intended for distribution in countries using the metrical system, and of still persisting in retaining therein the intricate English standards of weights and measures. The British Foreign Office also calls the attention of home manufacturers to the disadvantages to foreign trade resulting from the retention of the English standards. The complaint comes from Peru that the law requires all shipping specifications to be made out in metric weights and measures, and if there are any errors in these specifications the purchasers are liable to a fine. This means that the specifications have to be made out twice, first in English, and then in metric, weights and measures, and the Peruvian correspondents of English manufacturers not unreasonably ask that the metric system be officially adopted in England or at least be used by manufacturers for the foreign market.

As the United States is now supposed to be tending toward an era of foreign trade and the introduction of its products into foreign markets, the warning of the English Decimal Association applies equally well to American manufacturers. The United States and England alone among civilized nations of the first rank seem blind to the advantages of adopting a system now in use among the other great nations of the world, and it is time that the subject should be more broadly considered. To machinery and the parts of machinery this question of dimensions especially applies, and it is in

the manufacture of machinery and hardware that the United States especially excels, and it should send its manufactures in these lines to all parts of the world. It is too much to expect that foreign purchasers will take the trouble to puzzle out quarters, pounds and ounces, yards, inches, gallons, pints, etc., into their metrical equivalents, and the country that supplies what they want, ready dimensioned to familiar standards and shipped in terms they can understand, will gain and retain the bulk of their trade, with little regard to comparative merit in the goods themselves. As already pointed out in this journal, the adoption of metrical standards in the manufacture of engines, machine tools, etc., is not such an enormously difficult task as some men would have us believe. In fact, some very prominent and more progressive English engine makers have already adopted the metrical system with marked advantage to themselves. Instead of changing all standards, templates, etc., at once to a radical metric basis, the metrical equivalents are simply stamped upon the old patterns, where these are still to be used; and in making new designs a closer adherence to metrical standards is adopted. In time, as old patterns pass out and new ones come in, the change will be complete and will be accomplished without undue strain upon finances or upon the traditional methods of the workmen. It is an experiment well worth trying by any American maker ambitious of a foreign market for his goods, and there is no doubt but that it would pay goodly interest upon any necessary trouble or temporary annoyance.

LOCOMOTIVE COUNTERBALANCES AND INJURIES TO TRACK.

The paper by Mr. R. A. Parke on the "Vertical Influence of the Counterbalance," published in our last issue, is on a subject whose importance is as great to those in charge of track and bridges as to those who are in charge of rolling stock. For example, we may instance the letter, published in our correspondence column last week, in which a division engineer reported finding some nearly new heavy rails badly bent, and under circumstances that left little doubt that some wrongly counterbalanced locomotive was the cause of the trouble.

The "hammer blow" of locomotives is a matter which has been considerably discussed, but it is doubtful if it is as yet generally understood and appreciated by those in charge of permanent way, or by railway managers. Even those in charge of rolling stock have generally contented themselves with adopting empirical rules for determining the proper weight of counterbalance; and the exact force exerted by it upon the track and upon the locomotive has been undetermined. Now a comparatively small unbalanced weight when revolving at high speed develops a surprisingly large centrifugal force, and with the high speeds and heavy locomotives now in use it is important to know just how great is this force. If we turn to that much-revered authority, "practical experience," we learn only that injuries to track from badly counterbalanced locomotives are becoming increasingly common. We are thus forced to the conclusion that the question can be answered in only one way, by computation; and in the paper by Mr. R. A. Parke, published in our last issue, this computation has been made and general formulas or rules have been developed by which the proper weight of counterbalance for any locomotive may be found, and the vertical effect produced by counterbalances of a given weight may be determined. It may be of interest to review briefly how this computation was made and the results which are obtaned.

In the first place, taking the driving wheel alone, with the connecting rods and parallel rods removed, for perfect balancing the centrifugal force of the counterbalance must just equal the centrifugal force of the crank-pin, and its hub. To compute this it is necessary simply to compute the weights of these parts and the distances of their centers of gravity from the center of the axle. Then for perfect balancing the moment of the counterpoise, or its weight multiplied by the distance out to its center of wheel must equal the moment of the crank-pin and the surplus weight of metal about it. We should say here that our criticism in connection with Mr. Parke's paper in our last issue that the radius of gyration should be used in computing the centrifugal force instead of the distance out to the center of gravity was an error.

Next the additional amount of counterweight needed to balance the centrifugal force of the parallel rod is computed; and this is done in the same way, for the weight of parallel rod which the wheel carries is equivalent to a weight concentrated at the crank center, so far as centrifugal force is concerned. If these simple computations are correctly made, the counterweights thus found will place all the drivers in perfect balance so far as the revolving parts are concerned.

Thus far the process of balancing is the same that has long been in general use. Next comes the question, What is the vertical effect of the main rod and the reciprocating parts upon the main driver? The main rod, as every one knows, has a peculiar compound motion. One end reciprocates back and forth while the crank-pin end rotates in a circle. Heretofore locomotive designers have generally contented themselves with assuming that one-half the weight of this rod should be considered as a revolving weight and the other end should be included with the reciprocating parts. Mr. Parke attacks this problem and computes just what is the actual vertical effect of the main rod and the parts which move with it upon the main driver. The rule which he develops is as follows:

The additional centrifugal force which must be developed by the counterbalance of the main driver to balance the vertical effect of the main rod and its attached parts equals the weight of the main rod multiplied by the quantity:

$$r\,\frac{\frac{3}{8}\,r^2 + \frac{1}{4}\,l^2 - \frac{5}{8}\,r\,l}{s - r^2}$$

plus the weight of the piston, piston rod and cross-head multiplied by the quantity:

$$r\,\frac{r^2}{l^2 - r^2}.$$

In these equations r = the distance from the center of the axle to the center of the crank-pin, and l = the length of the main rod.

With counterweights adjusted according to the foregoing rules, all the driving wheels will be in perfect vertical balance, and there will be no increase of pressure on the rail when the counterbalance weights are down and no tendency to lift the drivers from the rail when the counterbalances are on top. It is necessary, however, to add something to the counterbalance weights to balance the horizontal effect of the reciprocating parts; if this is not done the locomotive pulls its train with the jerking motion familiar to all railway travelers, for the inertia of the piston, piston rod and cross-head, if not balanced by weights in the wheel, must be communicated to the whole train at the end of every stroke. Practice varies greatly as to what proportion of the weight of the reciprocating parts is counterbalanced. It is to be remembered that all the weight put in the wheels to balance these reciprocating forces exerts its full centrifugal force upon the track when the counterweights are down and tends to lift the wheels from the rail when the weights are at the highest point. The determination what percentage of the weight of the reciprocating parts shall be balanced is a matter for the heads of departments to settle, but whatever it be, the following rule for determining the weight of counterbalance necessary was developed by Mr. Parke:

The centrifugal force required to balance a given percentage (= m) of the weight of the reciprocating parts equals

$$\frac{m\,r}{l^2 - r^2}$$

multiplied by the quantity:

Weight of connecting rod ($\frac{1}{2}\,l^2 - \frac{1}{4}\,r^2 + \frac{5}{8}\,r\,l$) plus
Weight of piston, piston rod and cross-head ($l^2 - 2\,r^2$).
The quantities r and l have the same values as above.

It will be seen that the rules formulated by Mr. Parke are exceedingly simple and easy of application; and that by them the proper weight of counterbalance can be readily computed for any locomotive, when once the decision is reached as to what percentage of the reciprocating weights shall be counterbalanced. It is strange, indeed, that a practical and accurate computation of the proper weight for locomotive counterbalancing has not before been made, but, so far as we can learn, no such determination is on record in technical literature as that which Mr. Parke has made.

We alluded at the outset of this paper to the injuries done to track by badly balanced locomotives. The most common errors in counterbalancing appear to be placing too little weight on the main driver, thus increasing to an unnecessary degree the hammer blow of the counterweights in the other driver or drivers. This is frequently due to the difficulty on freight locomotives with small drivers of getting sufficient metal in the space available on the main driver to counterbalance both the revolving parts and that driver's share of the reciprocating parts. Whether it can be called an error to balance the full weight of the reciprocating parts or not, computation shows that where this is done, even when the weight is properly distributed among the wheels, the increase of pressure on the rail when the counterweights are down becomes seriously large at high speeds. All these things point to the necessity for a reform in the material and the design of reciprocating parts on American locomotives. No visitor to the World's Fair who carefully examined the locomotive exhibits could fail to be impressed with the contrast between the size of the side rods on American locomotives and on those shown by foreign exhibitors. As is well known cast iron pistons are still universal here and practically no attempt has yet been made to lighten reciprocating parts by American designers. That it could easily be done will hardly be denied. Cast or forged steel for pistons, and rods forged from high-grade nickel-steel would give as great strength as now with a large reduction of weight, and this reduction, it is to be borne in mind, would go far to offset the extra expense of the better grade of metal.

It is not only economy, but safety, which demands this reform. Experiments were recently made on the locomotive at Purdue University,* which is mounted, as our readers will remember, on idler wheels, to determine whether the driver lifted from the rail at high speeds, when the counterbalance was uppermost. The experiments were made by running annealed iron wires 3-64 in. in diameter between the tread of the driver and the supporting wheel, and showed that at a speed of 50 miles per hour the trailing wheel lifted from the rail. This engine has all the weight of the reciprocating parts balanced; a necessity on account of its method of mounting. Computation by the rules developed by Mr. Parke shows that lifting from the rail might be expected to occur at about this speed where the weight of the reciprocating parts is fully balanced.

Whether derailment would ever occur from this cause may be questioned, but there can be no question that an amount of centrifugal force which is sufficient to lift the wheel from the rail and which therefore practically doubles the pressure on the rail when the counterweights are down is a dangerous excess of pressure for track and structures in the case of heavy locomotives.

Another matter which deserves investigation in this connection is the enormous internal strains which are set up in wheel centers, and which it is not at all impossible may be communicated to a considerable extent to the tires. This depends entirely on the actual weight of the parts and not on the perfection or imperfection of the balancing. It is evident, therefore, that only by lightening all the parts whose centrifugal force is opposed to the counterpoise can these internal strains be reduced.

One of the stock arguments of those who urge the substitution of electric motors for steam locomotives, is the injury done and the limitations to high speed imposed by the reciprocating action of the locomotive. But the locomotive has already reached speed records of over 100 miles per hour, when no great attempt has been made to lighten its reciprocating parts. If, then, a locomotive were to be designed with the lightest possible reciprocating parts, especially for high speed service, it is evident that so far as the limitations due to its re- dent that so far as the limitations due to re- speeds than have yet been recorded might be attained without resorting to electricity.

* Engineering News, May 19, 1892.

LETTERS TO THE EDITOR.

METHODS OF PLOTTING ANGLES.

Sir: In my letter on plotting angles, etc., published in your last issue (p. 161, near end of first column), the typesetter makes me refer to "sixteenths" of a minute in reading angles. What I meant to write, and (as I remember it), did write, was "sixtieths."

T. P. Perkins.

Boston, Feb. 23, 1894.

SOARING FLIGHT.

Sir: Since reading Mr. Wellington's paper on soaring flight, published by you in October last, a doubt has arisen in my mind which I cannot get rid of. There is just one thing about it that I cannot explain, but that seems to be an all-important one. Wherein does a large body of air moving uniformly differ from a stationary one as seen from the standpoint of a bird completely surrounded by it?

Suppose the wind to be blowing steadily at 20 miles per hour and the bird to be moving with it; then, so far as the bird is concerned, what difference does it make whether we consider the situation as stated or we consider the air as stationary, but with an earth somewhere below moving 20 miles an hour in the opposite direction? and in the latter case, what difference does it make to the bird whether that earth is moving 20 miles an hour or not? In other words, when the bird is up in the air, how does he know whether it blows or not?

Until this question began to puzzle me I was quite delighted with the theory and with the clear and convincing way in which the phenomenon of soaring was explained. Now my mind is troubled, and I hope you will set it at rest with an explanation. The whole theory is so elegant that I am very anxious to have my faith in it restored completely.

In return I can suggest the possibility of man's learning to perform all the movements required in soaring by reflex action of the nerves and muscles without having to "stop to think" or use automatic mechanical or electrical appliances as mentioned in Mr. Wellington's paper under (6). Either of them would probably be too slow. Already now we have learned to do various things by reflex action that we were never born to do. We were not born to swim, or at least not to skate or to ride a bicycle, and in either sport it requires a very short practice to acquire the power to perform every necessary movement without thinking. We turn around in the water by kicking out in a certain way without knowing afterward how we did it; we simply intend to turn to the left or the right, and we do it. In the same way with the other sports. I have even held the tiller of a boat while I was almost asleep and still kept the boat fairly close to the wind, the varying pressure of the tiller on my arm would tell my muscles what to do without troubling my mind about it in the least. Is it then anything but plain logic to conclude that we can learn to soar as well without having to take a table of logarithms with us in order to make out what to do? The problem is to enable us to practice soaring without getting killed every time we make a mistake. Until that difficulty can be overcome it is hopeless. Perhaps a lake of suitable size, and with say 5 ft. of water all over, would afford good practicing grounds.

Yours truly,

Otto Sonne.

Boston, Mass., Dec. 30, 1893.

(Our correspondent's last suggestion is pertinent and sound in principle, and no one can pronounce it unsound in fact; but for many reasons, which it would take too long to summarize, we do not believe that man will ever learn to fly through the air as the bird does, or, as he learns to walk or use a bicycle, by reflex action of his own nerves and muscles solely. In the beginning at least the conclusion seems justified that the machine must be such that he is not called upon to use any quicker intelligence in guiding it than he is in steering a boat.

The answer to the first query will be evident if he remembers that it is not simply a question of relative velocity. The primary necessity for continuous soaring flight is a continuous, if small, supply of new energy to replace the continuous small loss of friction. Energy is a substantial—or at least a real and measurable thing, as much so as sugar or starch. If we are to consume it continuously we must have a continuous source of supply. Moving air is such a source of supply; still air is not. The conditions of motion at a given instant are the same if the relative velocity of bird and air are the same, whether the bird be moving and the air still or vice versa. But the available store of energy for continuous motion without muscular effort is in the one case only the very limited supply in the bird's body, and in the other case the practically infinite supply stored in the moving air. Therefore, in the one case soaring is possible only for a few moments, and in the other may be indefinitely continued until the wind dies out.—Ed.)

CONCERNING THE MISSISSIPPI RIVER BRIDGE NEAR NEW ORLEANS.

Sir: In the editorial columns of your issue of Feb. 22 you state that "The proposal of the Phoenix Bridge Co. for the construction of a bridge over the Mississippi River at New Orleans has been accepted by the Southern Pacific Co." I wish to correct this statement so far as the use of the Southern Pacific Company's name is concerned. That company has no charter for building a bridge over the Mississippi at New Orleans, nor, to my knowledge, does it propose to build a bridge. The charter was given by Congress to the Southern Bridge & Railway Co., and this company is proposing to build a bridge and to operate it as an independent company for the benefit of all of the railways centering at New Orleans, and also in the interest of the city of New Orleans.

The preliminary work so far done, and that now being done, is under the direction of this company, and for your information I will state that I am now engaged in working out the detail plans of the substructure of the main bridge and the principal features of the superstructure; also making further examinations and surveys on the ground at New Orleans in order to decide definitely upon the exact location of the bridge.

I am yours truly,

E. L. Corthell,

Prest. and Chief Engineer Southern Bridge & Railway Co.

Chicago, Feb. 26, 1894.

SHARP CURVES IN RAILWAY TRACKS.

Sir: Referring to your article in the issue of Feb. 8, 1894, on "Sharp Curves in Railway Track" we have in Cincinnati two sidings curved out of the street connection railway into the houses of the Chicago beef companies, one of which is laid with a 52-ft. radius and the other with a 50-ft. radius. The sidings extend over an angle of 90°. We also have sidings of 80 ft. and 100-ft. radius, over which our Class "M" (six driver) engines work regularly.

On the sharp curves mentioned above we have used an engine with a 7-ft. wheel base without any leading or trailing trucks; but on account of the tracks being in the street, and the Wharton rails, with which the Wharton rails are laid, becoming filled with street dirt, it is our practice to rope the cars in and out of the house.

Yours truly, C. E. Lindsay.

Eng. Maintenance of Way, P., C., C. & St. L. Ry.

Cincinnati, O., Feb. 10, 1894.

Sir: Referring to sharp curves built at New York, on the New York Central & Hudson River R. R., and illustrated in your issue of Feb. 8, I inclose sketch of two sharp curves at Cincinnati on the Cleveland, Cincinnati, Chicago & St. Louis Ry., built in March, 1891, and described in your issue of Nov. 21, 1891. These curves are of still shorter radius than the New York Central curves, and I believe the shortest curves used in regular daily service. The switching is done by a "Pony" engine, 7.6-ft. wheel base; the shackle bar between engine and tender was slightly lengthened and hose transferred from sides to center line, to prevent corners jamming and tearing hose. Bar links, with pin holes 12 ins. apart, are used in place of the ordinary links, between the cars to spread them apart and prevent the corners striking. Two to four cars is the usual length of train pushed into these tracks.

Yours truly, E. A. Hermann.

2608 Lafayette Ave., St. Louis, Feb. 17, 1894.

THE EAST PROVIDENCE STAND-PIPE FAILURE.

Sir: Having been in charge of the construction of the original East Providence water-works in 1880-1, I have noted, with interest, the expansion of the system, resulting in the construction of new works, making the town independent of the city of Pawtucket, from which the first works was supplied. The cause of the failure of the stand-pipe, connected with the new works, but, as I understand, not accepted by the town at the time of its destruction, seems to be unexplained.

From Mr. Leland's account (Eng. News, Jan. 25) it appears there was less than 100 ft. of water in the pipe at the time of failure, and that the point of rupture was about 55 ft. from the bottom. There was, therefore, at the bursting point, but about 20 lbs. per sq. in. pressure, due to static head. The skillful and well known chief engineer, Mr. S. M. Gray, seems to have exercised his usual care in securing sound work, and it seems incredible that the break could have been caused by static pressure.

Of course, at this distance, it is impossible to do more than theorize, but the idea suggests itself that the rupture might have been caused by the sudden expansion of the water in the pipe, in the act of freezing, in the same manner that pitchers are so often broken in cold weather. I should like to have your readers' idea as to the soundness of this theory.

Mr. B. F. Stephens, in his able paper on stand-pipes, read before the American Water-Works Association, in 1888 (Eng. News, Oct. 6, 1888), does not consider it necessary to cover these structures to prevent freezing. He says: "Frequent pumping at intervals of 8 to 10 hours into the stand-pipe, and letting out for changing the water on coldest days, is the sure, easy and economical preventative against freezing." In this connection a statement as to the temperature at time of accident would be of interest.

Yours truly, C. H. M. Blake.

Guadalajara, Mexico, Feb. 17, 1894.

CELLULOID SCALES.

Sir: Can any one tell me the difference, if there is any, between the "U. S. Standard" and the "Darling, Brown & Sharpe Standard" for draftsmen's scales, and which of the two is correct? Some time since I purchased two "white-edge" scales, and after keeping them for some time, compared them with each other, and with a plain wooden triangular scale, and found that they all differed in length. The manufacturers advised me that the "white-edge" is made of celluloid, and that it will shrink. Why don't they state in their catalogue that such scales will alter more in length than the ordinary ones? Yours truly, Howard Eavenson.

Colburn, Va., Feb. 19, 1894.

("A pint's a pound the world around," says the old adage. Save for the differences due to errors in manufacture, or alterations in length afterward, all measures of length in commercial use are intended to be uniform, and a Darling, Brown & Sharpe foot should be the same as the foot of any other maker. The note as to the inaccuracy of celluloid scales will be of interest to purchasers of drawing instruments. We have referred our correspondent's query to a prominent manufacturer, who informs us that in making white edge scales, the best practice is to use the celluloid only as a very thin strip firmly glued to the boxwood. When so made it contracts and expands with the wood, but solid celluloid, as our correspondent says, is apt to shrink.—Ed.)

A PROBLEM IN HYDRAULICS.

Sir: Some of your readers will doubtless be interested in the following problem and its solution, of recent occurrence in classwork: Given an ample water supply for the purpose, and a clean iron supply pipe 3 ins. in diameter and 800 ft. in length, leading from a reservoir or pond to a Pelton wheel or other jet-motor. The head is 100 ft., and the pipe fairly straight. It is required to determine, for the tip of the nozzle to be attached to the end of the pipe for delivering the jet upon the wheel, such a diameter as to obtain a maximum power; i. e., so that the kinetic energy of the water flowing per second shall be a maximum. The jet is "free"; i. e., traverses the air a short distance before meeting the wheel cups.

Since the pipe is comparatively long, we may neglect all losses of head except that due to fluid friction, which takes the form $f \frac{l}{\frac{1}{4}d} \cdot \frac{v'^2}{2g}$, where v' is the velocity of the water in the pipe during a steady flow, l the length and d the diameter of the pipe, g the acceration of gravity, and f a coefficient (the same as Mr. Fanning's "m"); $\frac{1}{4}d$ is the hydraulic radius of the pipe section.

Using the foot, pound, and second as units, and a value of 0.007 for f, we find on substitution that the friction-head reduces to $89.6 \frac{v'^2}{2g}$, where g is 32.2. Let x be any value that we may assign for the diameter of the tip of the nozzle (supposed to be so shaped that there is no contraction, the jet also having a diameter = x). Then, since the velocities at nozzle-tip and in supply pipe are inversely proportional to the sectional areas, or squares of the diameters, we have (since $d = \frac{1}{4}$ ft.) for the velocity of the jet in the air, $v = \frac{v'}{16x^2}$; or $v' = 16x^2 v$; whence the friction head may be written, $22938 \frac{x^4 v^2}{2g}$.

From the law of Bernoulli for steady flow we now have

$$\frac{v^2}{2g} = 100 - 22938 \frac{x^4 v^2}{2g};$$

whence

$$v = \sqrt{\frac{200g}{1 + 22938\, x^4}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

for the velocity of the jet, for any assigned diameter, x, of nozzle-tip, less than ¼ ft. Since water weighs $\gamma = 62.4$ lbs., per cubic foot, the weight of water flowing per second when the nozzle-tip has a diameter of x will be $\frac{\pi}{4} x^2 v \gamma$; and the kinetic energy resident in it by vir

of its velocity is $\frac{\pi}{4}\gamma\ x^2 v.\frac{v^2}{2g}$ (or mass × half-square of velocity). Hence the kinetic energy (ft.-lbs. per second) of the jet in steady flow is,

$$\text{K. e. per sec.} = \frac{\pi}{4}\cdot\frac{\gamma}{2g}\left[\frac{200\,g\,x^{4/3}}{1+22938\,x^4}\right]^{3/2} \quad \ldots\ldots(2)$$

This expression, as x is given various values, will be a maximum when $\left(\frac{x^{4/3}}{1+22938\,x^4}\right)$ is a maximum or $\left(\frac{1}{x^{-4/3}+22938\,x^{8/3}}\right)$ is a maximum; or when $u = x^{-4/3}+22938\,x^{8/3}$ is a minimum.

By differentiation we obtain: $\frac{du}{dx} = -\frac{4}{3}\ x^{-7/3} + (^8/_3)\ 22938\ x^{5/3}$. If this is put = zero, there results $45876\ x^4 = 1$; or x = 0.0684 ft., = 0.82 in., as the particular value of x for a maximum power in the jet (or which makes the function u a minimum; the second differential coefficient, if found and used, would indicate a minimum).

Having computed the velocity in the pipe corresponding to this value of x, and the assumed 0.007 for f, we may be obliged to choose a new value for f, from Mr. Fanning's tables, and recast the entire work.

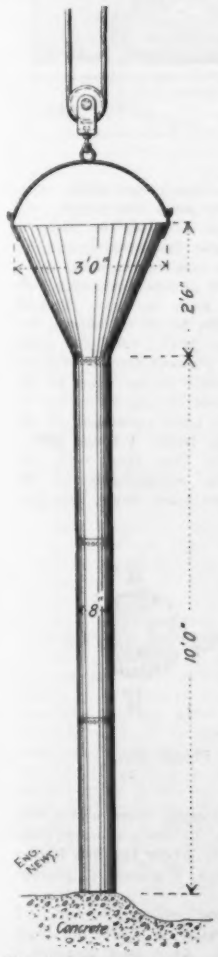
As a check we find, on substituting successively 0.8, 0.07, and 0.06 ft. in expression (2), results that are proportional, respectively, to the numbers 829, 858, and 839.

[For x = ¼ ft., the quantity of water flowing per second would be a maximum, f being considered constant; while if x be made (nearly) = zero, we have a maximum velocity in the jet, = $4\sqrt{2\,g\,100}$, less 4 or 5% for friction of nozzle.] Sincerely yours, I. P. Church.

Ithaca, N. Y., Dec. 23, 1893.

DEPOSITING CONCRETE UNDER WATER AND MIXING IT IN COLD WEATHER.

Sir: I have had frequent occasion to build concrete foundations under water, and after trying the bag system and several other methods, with unsatisfactory results, I have devised a system which has proved successful. I used a stout iron hopper and delivery tube (as shown in cut), made any required length, with a stout bail by which it is suspended a few inches above the bottom by means of a derrick or other support. Wheelbarrows are used in filling the hopper with concrete, and when once the hopper and tube are filled, the derrick is used to raise the whole a few inches, the hopper being kept full or nearly so, and the derrick swinging gently so as to allow the feeder to travel over the whole area to be filled, care being taken to keep it at about the same level so as to deposit the concrete in layers of a uniform thickness. A little care in following the above directions will keep the water from rushing up through the tube and cause the concrete to be deposited on the bottom with no opportunity for wash in its passage through the water.



Pipe for Depositing Concrete under Water.

I have in this way deposited Portland cement concrete in 18 ft. of water, and on pumping the pit dry to start the masonry, found it level and solid, the cement being firmly set. In depositing concrete under water in midwinter I have found it greatly facilitated the setting of the cement to put a jet of steam from an adjacent boiler into the water inside the cofferdam inclosure.

I have used this system successfully in works for the city of Lowell, the city of Boston, on "Harvard Bridge" foundations, and the Brooklyn Heights Railway Co. at their large power house, now nearly completed.

Having had occasion to put in foundation work many thousand cubic yards of Portland cement concrete for the West End Street Ry., of Boston and the Brooklyn Heights R. R. of Brooklyn, N. Y. much of which was required to be done in winter, it may be well to describe the method used in work exposed to a low atmospheric temperature. A large water-tight tank, open at the top, was constructed, of such dimensions as would allow three ordinary dirt boxes to be lowered into it at the same time. This tank was filled with water and a jet of steam kept the water hot in the coldest weather. The broken stone, or cobbles, designed for the concrete, were loaded into these boxes and lowered into the tank of hot water. A bath of a few minutes' duration heats the stones to the temperature of the water. One of the boxes is then hoisted out and dumped on one side of the mixing machine, the stone with sand and water in proper proportions is run through the machine and wheeled to place of deposit without delay. In this way, with layers 10 or 12 ins. deep, well rammed, the heat is retained until the cement becomes firmly set and makes an almost impenetrable mass. In severely cold weather additional protection is secured by heating the sand and water before using. When the temperature is low it is well to protect the work by a cover of hay, gunny cloth or other convenient material. By this process the best of results can be secured and at no greater cost than a good quality of masonry with the advantage that the construction can go on in all seasons of the year, with the exception, perhaps, of a few of the very coldest days.

Yours truly,
Wm. H. Ward, Contractor.

LONG STEEL TAPES.

Sir: Since the subject is being discussed as to the early use of long steel tapes let me state that in 1879 Mr. Alfred Noble, then U. S. Asst. Engineer under Major Weitzel, was in charge of the survey of St. Mary's River, between Lake Superior and Lake Huron. In this survey there were five base lines, measured with a 500-ft. steel tape, supported at intervals on pulleys set in stakes, uniform tension being produced by a weight attached to one end by a cord passing over a pulley, and the distances marked by punch marks in the head of nails driven in stout stakes that were independent of the pulley stakes. Each 500-ft. section of the base lines was measured by bringing the zero graduation over the punch mark, then raising the weight at the other end a few inches and lowering it gently. The distance between the 500-ft. graduation and the punch mark was then read with a common triangular scale. This operation was repeated a few times and the mean recorded, at the same time the temperature was observed and recorded. C. D. Hill.

Chicago, Feb. 24, 1894.

NOTES AND QUERIES.

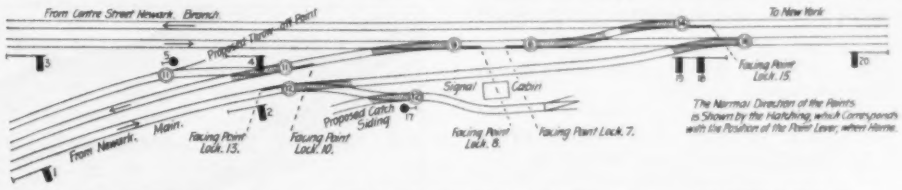
G. A. C. inquires concerning the practice and experience of city engineers who have found it necessary to adopt grades of less than 6 ins. in 100 ft. He wants to know how flat a gradient has been successfully used; how storm-water is disposed of on these grades; how often catch-basins are put in, and whether the grade of the gutter between catch-basins is ever greater than the curb grade. Tables exist of maximum gradients in cities, and the treatment of steep gradients is quite fully handled in published work upon municipal engineering; but we do not think the subject of minimum possible gradients has been so fully treated. Our correspondent will, however, find considerable practical information on the subject in Staley & Pierson's "Separate System of Sewerage," and may also refer to Baumeister's "Cleaning and Sewerage of Cities" and Dempsey & Clark's "Drainage of Lands, Towns and Cities." Perhaps some of our readers from far Western towns can answer our correspondent's questions from their own experience.

AN OLD INTERLOCKING PLANT.

Many of our readers who visited the exhibit of the Pennsylvania R. R. Co., at the World's Columbian Exposition last year, probably noted with some curiosity the exhibit of the original 20-lever interlocking frame, used on the first plant of interlocked switches and signals erected in this country. This plant was erected in 1874 by Saxby & Farmer, the English signal engineers, and interlocked the crossing of the Center St. Branch and main line tracks of the Pennsylvania R. R. at a point about one mile east of Newark, N. J. Through the courtesy of Mr. H. M. Sperry, of the Johnson Signal Co., we are enabled to illustrate the general arrangement of the tracks at this point.

As stated before, this plant was erected by the well known English firm of Saxby & Farmer, all the parts, including even the oak semaphore posts, being manufactured in England and shipped to this country, where they were erected by a force of English workmen. It is worthy of note in this connection that so carefully were the construction and erection carried out that when the plant was put in operation it was found that all parts worked with absolute precision. In its general features the design of the apparatus did not differ much from that of modern interlocking plants. The signal cabins were of the English type, having a lower story of brick and an upper frame with windows on all sides. The machine differed but slightly from the present type except in respect to the locks, which were of the flop pattern. The bed plate was made in five lever sections and on each lever in addition to its number was given the combination of the levers which must be operated in order to release it. A brass plate was also mounted on the machine opposite each lever giving its purpose.

The signals were of the English type, the semaphore arms dropping into a slot in the top of the post. The connections to the switches and locks were of 1-in. pipe; the semaphores were operated by a single wire. It will be noted in referring to the diagram, which is reproduced from a copy of the original drawing furnished by Saxby & Farmer, that semaphores 18, 19 and 20 point to the left. This was an error in the drawing, as all the semaphores pointed to the right.


From Centre Street Newark Branch
Proposed Throw-in Point
To New York
Signal Cabin
Facing Point Lock. 15
The Normal Direction of the Points is Shown by the Hatching, which Corresponds with the Position of the Point Lever, when Home.
From Newark Main
Facing Point Lock. 13.
Facing Point Lock. 10.
Proposed Catch Siding
Facing Point Lock. 8.
Facing Point Lock. 7.
PLAN OF INTERLOCKING PLANT AT EAST NEWARK JUNCTION, N. J., PENNSYLVANIA R. R.
Constructed by Saxby & Farmer in 1874. Drawn from the Contractor's Original Plan.

In examining the diagram it will be seen that the cross-over 6-14 is operated by two levers. No signal is provided for a movement to the siding over switch 12, and signal 18 and 19, consisting of two arms, governs three routes, viz., main line via 14-6-9, branch via 14 and switch via 14-6-9 and 11. The diagram shows facing point locks and separate levers for every signal, and protection for the main line by derails in the sidings. Two styles of derails are shown, one with a single rail (No. 11) and the other a complete switch and short piece of track. The diagram shows no low signals for reverse movements, and no detector bar for switch 16. With these few exceptions it will be seen that this plant erected a score of years ago agrees pretty closely with present practice.

SPECIFICATIONS AND BIDS FOR SMOKE ABATEMENT AT KANSAS CITY, MO.

The "smoke nuisance" question is of such importance at present as to make the detailed information given below regarding attempts to abate it of much interest. The Board of Public Works of Kansas City, Mo., received bids on Feb. 20 for devices for the prevention and abatement of smoke from the furnaces of the city hall heating and power plant. This plant consists of three 5×18-ft. boilers, and proposals were asked for fitting two boilers, with the option of ordering the third fitted at a later date. The specifications called for a 60-days test of the devices, during which the smoke from the stack must be reduced to the satisfaction of the Board of Public Works, the results to be at least equal to those now obtained by the Murphy furnace in use at the Exchange Building, in Kansas City. The board proposes to base its comparisons on photographs of the City Hall and Exchange Building smokestacks. The device must furnish an equal power with the same coal consumption as the present plant and must not damage the boiler plant.

Mr. Peter H. Tiernan is President of the Board of Public Works, and Mr. H. P. Langworthy, to whom we are indebted for this information, is Secretary. The bids were as follows:

F. D. McCollum, Kansas City, for Frank Barclay, patentee, offered to fit two boilers with the Barclay smoke consumer and fuel saving device at $275 each.

The Hawley Down Draft Furnace Co., Chicago, Ill., two or three Hawley down draft furnaces for $800, with guarantee to consume 95% of the smoke from any grade of bituminous coal and to increase the efficiency of boiler 40% over the rated capacity, or burning slack coal to save 10% in cost of fuel over present method of making steam.

O. H. Schramm, Kansas City, for Jogada Furnace Co., Chicago, Ill., two or three boilers with the "Jones Underfeed Mechanical Stokers" for the sum of $585 each, guaranteeing that the stokers, when properly operated, will show an actual saving in fuel of not less than 10% over the results now obtained in the City Hall plant by hand firing. Would put in one furnace for trial for $625, and then put in the other two so as to make the total $1,755.

James Cotter, Kansas City, two or three boilers with the Burke smokeless furnace for $600 each.

Murphy Iron Works, Detroit, Mich., Murphy automatic smokeless furnace for two boilers for $2,086, and a third furnace, if taken in connection with the other two, for $988; if taken subsequently and separately, $50 additional. This company also stated that: "We will, if our proposition is accepted, donate to the city the sum of $500, which you are hereby authorized to withhold in the settlement of the contract entered into in pursuance of the proposition herewith."

A. W. Colwell, New York, two down draft complete combustion furnaces, with water grate bars, for $1,750, and a third for $900.

Jeffrey & Weston, St. Louis, Mo., three standard smokeless furnaces for the City Hall, set up and in running order complete, for $2,000.

THE UNITED STATES VS. THE WORLD, IN THE PRODUCTION OF IRON AND STEEL.

A late paper on "The Chicago World's Fair and its Lessons to the Iron Trade of Great Britain," read by Mr. J. S. Jeans, before the British Iron Trade Association, recalls some interesting facts which have been before noted, but which will bear repetition, especially in their present form. Mr. Jeans fully recognizes our achievements in the development of the iron and steel industries in the last 15 years and shows by cold statistics that England has lost her supremacy, not only as a maker of iron, steel and malleable iron, but also as the first ore-producing country in the world. The following table shows the relative standing of the iron producing nations of the world in 1877 and 1892 in the production of pig iron:

	1877. Tons.	1892. Tons.
United States	2,066,000	9,157,000
Great Britain	6,608,000	6,616,000
Germany	1,614,000	4,793,000
France	1,453,000	2,023,000
Belgium	499,000	768,000
Austro-Hungary	400,000	935,000
Russia	450,000	915,000
Spain	43,000	179,000*
Italy	24,000	12,000*
Sweden	351,000	491,000*
Other countries	60,000	92,000
Totals	13,559,000	25,979,000

*1891.

Note.—In this period the pig iron output of England had advanced to 8,493,000 tons, and in 1890 the United States reached a maximum output of 9,202,000 tons.

This is an increase of 91.6%, in the period 1877-92, in the world's production of pig iron. The percentage of the world's make contributed by the three principal producers in 1877 and 1892 is:

	1877.	1892.
United States	15.3	35.2
United Kingdom	48.9	25.4
Germany	11.9	18.4

Mr. Jeans gives the percentage of increase in pig iron production for this period, 1877-92, as follows:

United States	343%
United Kingdom	0.1%
Germany	197%

To add to England's trouble the writer points out that 17 years ago only about 8% of the total British production of pig iron was made from imported ore, while in 1892 over 20% of the ore used was obtained from foreign sources of supply. On the other hand, both the United States and Germany have radically reduced their ore importations in the same time.

The world's output of Bessemer steel has been very irregular in these 20 years or more, being mainly influenced by the rise and fall in railway construction. The following table showing the Bessemer steel output in 1878 and 1892 is given with this caution:

	1878. Tons.	1892. Tons.
United States	534,000	4,168,000
Great Britain	762,000	1,501,000
Germany	390,000	1,900,000
France	218,000	510,000
Belgium	75,000	210,000
Austro-Hungary	97,000	220,000
Russia	8,000	95,000
Sweden	22,000	191,000
Spain	.....	130,000
Totals	2,106,000	9,825,000

The percentage of the world's make of Bessemer steel and the percentage of increase for these 15 years are given as follows:

	Percentage of world's make.		Percentage of increase.
	1877.	1892.	
United States	25.0	42.0	680
United Kingdom	42.0	15.0	97
Germany	18.5	19.3	387
Other countries	14.5	23.7	11.2
Totals	100.00	100.00	

To sum up these figures, it appears that while in 1877 England produced nearly 40% of the world's output of pig iron and 42% of the Bessemer output, in 1892 these figures stood at 25% for the first and 15% for the second. The United States, on the other hand, has seen her production of pig iron rise from 15% of the world's output, in 1877, to over 35% in 1892; and her Bessemer steel output has risen from 25% to 42%, thus appropriating the figures of England for 1877. These percentages are especially important when viewed in connection with the enormous increase in the world's production of pig iron and Bessemer steel in the period under consideration, the first having increased 91.6% and the second, over 466%. In the production of open-hearth steel alone England still holds her supremacy and she now produces twice as much of this steel as either the United States or any other country. But the United States is advancing rapidly in the manufacture of this material; for while in 1888 our output was only about 25% of England's output, in 1892 the production of open-hearth steel in the United States was equal to 50% of England's production. Germany is advancing at an almost equally rapid rate in this class of production.

SURVEY OF AN UNDERGROUND CONNECTION AT LEAVENWORTH, KAN.*

By Edwin A. Sperry.

The following is a description of the survey made by me for the underground tunnel connection between the Riverside and Home coal shafts, at Leavenworth, Kan. The state law requires an escape shaft, and as neither of the shafts had one, the two companies decided to make this connection in order to comply with the law and still escape the great expense of sinking two additional shafts. Being the engineer of the Kansas & Texas Coal Co., of St. Louis, Mo., owning the Riverside mine, I was detailed to make the surveys. The shafts were about 5,020 ft. apart, and I was instructed to start work at both ends, that it might be driven more rapidly. Fig. 1 is a map of the connection.

I started the surveys Dec. 1, 1891, and on Dec. 31, 1892, the headings were broken through, with an error of less than 3 ft. in lateral measurement, and about 2 ins. in length. These results, I think, are very good, when the circumstances are taken into consideration. In the first place I was obliged to work with green men, such as I could pick up around a coal mine, who had had but a trifling experience of this kind. Then I had to drop my base lines 720 ft. down each of the two shafts, which were but 10 ft. in width, giving me a base of less than 10 ft. in either case. Finally, the line of the tunnel was so located as to run down the middle of the Missouri River, which made it impossible to check on the surface further than by running down the river bank, along the bluffs. These special difficulties required exceptional care. My plan of operation was as follows:

1. To tie the two shafts by carefully checked lines, three in number, down the Missouri Pacific Ry. track, using only parts of any one line for either of the others and thus checking the traverse on the various points.

2. To drop the base down the two shafts.

3. To run the underground lines to the point of starting in each mine. I had a fair opportunity to close in on some parts of my underground lines and I checked them as much as possible in this way.

In reading angles I repeated four times, taking the mean as my value. The instrument I used on the work was a Gurley light mountain transit. My measurements were made on the surface with a 500-ft. steel tape, made for me by the same firm. The underground measurements were made with a 100-ft. Chesterman steel tape.

The first problem, that of tying the two shafts, was one of comparative simplicity and consisted of checking and rechecking until the tie was as nearly absolute as possible. After this preliminary operation, what might fairly be called the real work was begun.

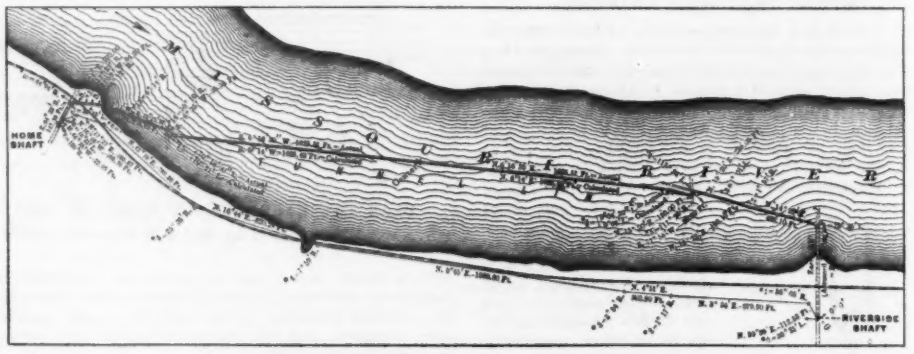


FIG. 1. MAP OF CONNECTING TUNNEL.

The second problem, that of dropping the bases in the shafts, was one of greater importance, and demanded, of course, the utmost care and accuracy of instrumental work. I first tried plumb lines with 5-lb. plumb-bobs. I used braided linen at first, thinking that lightness of the line would be an advantage, but found that this would not do. Next I tried fine piano wire, and although it was an improvement, it was not much better. I then sawed slits in the sides of the plumb-bobs, into which I inserted square pieces of sheet brass, in order to offer more resistance to the oil or water in which I hung them. I found this a great improvement, but even then they were not steady. Water was dropping considerably in the shafts, more especially in the home shaft, and notwithstanding the fans were stopped, there was a constant whirl of air, which threw the drops of water from side to side, so that when they struck the line it was with considerable force, enough, it seems, to prevent its settling perfectly.

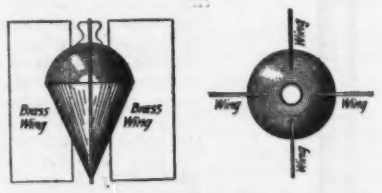


Fig. 2. Winged Plumb Bob.

Fig. 2 represents my "winged" plumb-bob, which, I think, would be highly serviceable in shafts not more than 200 or 300 ft. in depth. As a final measure I obtained from Messrs. Gurley a side telescope which A. S. Aloe & Co., of St. Louis, attached to my transit. In order to adjust the instrument thoroughly I suspended one of my "winged" plumb-bobs in oil, with fine piano wire, from a high trestle, on which I adjusted the axis on the standards after having adjusted the line

*Abstract of a paper presented at the February meeting of the American Institute of Mining Engineers.

for collimation in the main telescope. I then stretched two wires horizontally from the roofs of two buildings, making them as nearly parallel as possible by very careful measurement, and at a distance from each other equal to the distance between the centers of the two telescopes. I then set up my instrument exactly under the two wires, and with them checked the adjustments of both the line of collimation and the axes on the standards. Having these in perfect adjustment I then adjusted the side telescope to travel on the side wire or in line parallel to it. I also, with this wire, adjusted the hair as to its being vertical, both in the main as well as in the side telescope. In this way I brought both telescopes to work in planes as nearly parallel as possible.

There were two landings at each shaft, one about 20 ft. above the other. I brought my tie line to each shaft at the lower landing, placing small tacks (on which I had filed an X) on each side of the shaft, at a short distance from the edge, so that they could be easily seen from the upper landing.

I then took a 4 × 4-in. timber, long enough to reach across the shaft safely, through which I bored, at the middle, a ½-in. hole, and nailed a short board across one end. To this timber, through the hole, I bolted my tripod head, and placed it across the shaft so as to bring the tripod head at the center of the shaft. The short cross board at the end gave three points of bearing, thus insuring firmness. Having placed planks across the shaft I screwed my transit to the tripod head, which gave me a command of the entire shaft both above and below. I then carefully "whipped in" my

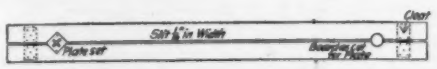


Fig. 3. Arrangement of Slits for Illumination of Line.

side telescope between the two tacks on the lower landing, and threw my sight to the bottom of the shaft. In this way I could eliminate almost any error in the adjustment. If the standard axes had been out the bearing of the line at the bottom would have been the same as above; if the hair had not been exactly vertical, the cross-hair intersection would have traveled on the same line; if the projection of the object-glass had not been perfectly true, it would have made the same error on each side of the shaft at the bottom. Of course it would have been desirable to have the line at the bottom absolutely coincident with the line at the top, and I endeavored to have it so; but if it was not exactly under, but was on the same bearing as the line above, the result would have been but slightly affected. I tried to have my instrument in perfect adjustment, and I am sure that it was quite so, but I did not want to take chances in this matter. It was rather too far to call easily, so I arranged a code of signals with the bell.

I found that it was impossible to use a direct light, so I had two straight-edges cleated together, leaving a slit between them 1-16 in. wide, as shown in Fig. 3. At first I used the boards as they were, but found that the changing temperature and the moisture in the shaft flared the light, even with as narrow a slit as this. I then tried sheet-iron plates in which I had cross-slits cut, placing the cross-slits at 45° with the main slit, between the straight-edges. Even this, with the naked light, was not very satisfactory, and I finally tried a bull's-eye lantern, using a common reflector to deflect the light up through the plates. I cut away the boards so as to allow the light to go up through the full length of the slits in the iron sheets, and, of course, placed the intersections of the slits in line with the slit in the boards. In this way I had only to set the cross-slits on the line, and the center of the slit between the boards indicated the line at any point in their entire length.

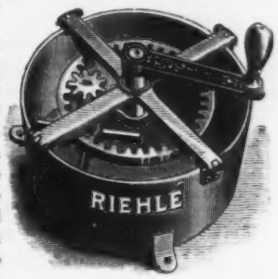
I checked these lines several times and found almost no perceptible variation, especially in the Riverside shaft. In the Home shaft the conditions were much less favorable, as before indicated. In fact, I found an error of about 3' in this shaft, or rather that the results seemed to locate it at this point, at which I was not at all surprised, as I looked for it here more than at any other point. In checking my line, as plumbed, with the line as projected with the instrument, I found in one case a variation of 30' in bearing, which would have been a very serious matter in the results.

The matter of levels did not enter into the problem, as the coal seam governed that entirely. The tunnel was timbered and lagged throughout. The dimensions of the tunnel were 7 ft. at the bottom, 6 ft. at the top and 5 ft. 5 ins. in the clear after timbering. The air was carried by a brattice the entire distance with good results. No trouble was experienced from warping and leaking of the board brattice.

Both the mines are worked on the long wall system, and of course it was necessary to remove the timbers as fast as the face reached them. The connection is closed by a system of "traps," so as to prevent any interference with the ventilation system of either mine, each being carried on perfectly independent of the other.

RIEHLE CEMENT MIXING MACHINE.

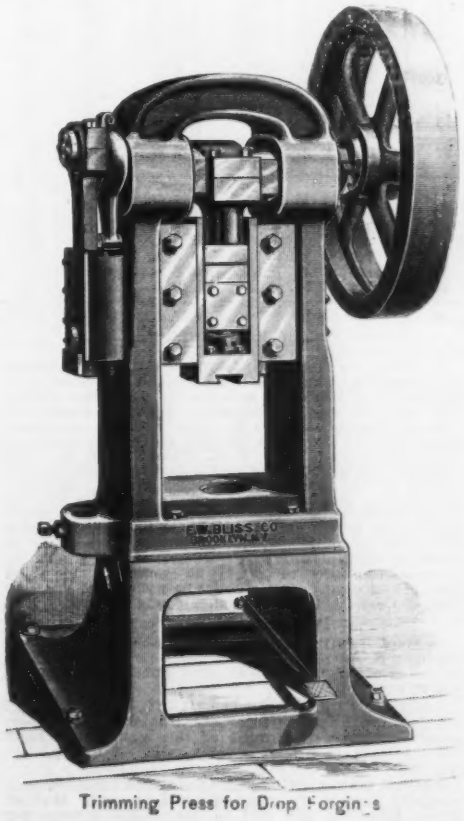
A handy apparatus for mixing cement in making test briquettes is shown in the above illustration. It consists of a substantial bowl of cast brass, fitted with cross arms, easily removable, which furnish a bearing for a center shaft. The hand crank when rotated transmits its motion to a short crank in the bowl, which carries a paddle which moves around the bowl. At the same time, a pinion on top of the paddle shaft engages with a fixed annular gear, which causes the paddle to rotate on its axis.



The combined movements thus given to the paddle mixer produce a thorough distribution of the contents to all parts. All the parts are of brass, except the hand crank, which is japanned. When ready to empty the bowl, all the working parts can be removed in a moment by drawing out a couple of pins. Such an appliance will be found very useful in mixing batches of cement in a regular and uniform manner. The dimensions of the machine are as follows: Diameter of bowl, 10 ins.; depth, 5 ins.; extreme height, 11½ ins. The device is manufactured by the Riehle Bros. Testing Machine Co., of Philadelphia.

TRIMMING PRESS FOR DROP FORGINGS.

The press illustrated herewith is intended for use in the forge shop where hot metal is to be trimmed. It is fitted with the Bliss clutch and a patented adjustment in the slide, and has a supplementary slide in the side of its frame to be used in cutting off the work from the bar after it is forged and trimmed, which is claimed to be a new feature in a press of this kind. The machine is strongly built and the details have been carefully worked out. The presses are built in several sizes and are



Trimming Press for Drop Forgings.

usually made with flywheels, as forgings are usually required to be trimmed very quickly. The press shown in the cut has a 4-in. stroke, 4-in. adjustment and is 15 ins. from bed to end of slide when up. The distance between uprights is 22 ins. It carries a 900-lb. flywheel and the total weight is about 5,500 lbs. The press can also be geared for cold trimming. Further particulars can be obtained from the makers, the E. W. Bliss Co., of Brooklyn, N. Y.

IRRIGATION EXPERIMENTS AND OBSERVATIONS IN UTAH.

The relative advantages of surface and subsurface irrigation have been studied at the experiment station of the Utah Agricultural College, Logan, Utah. The results and conclusions of the studies are given in Station Bulletin No. 26, by Mr. J. W. Sanborn, Director. The summary of conclusions is as follows:

(1) Sub-irrigation, whether by large open drains, or by the cement pipe system, fails to supply moisture enough for growing crops.
(2) The lateral movement of water was too slow to furnish the requisite supply for the evaporation of plants, being at the rate of a very few inches per day.
(3) The sub-irrigated soil was warmer than the surface irrigated soil.
(4) The atmosphere around the plants, to the height of 12 ins., was warmer by sub-irrigation than by surface irrigation.
(5) The sub-irrigated plat did not contain as much moisture as the surface irrigated plat.
(6) It is concluded that for the college farm the lateral movement of water cannot be made rapid enough for maximum crop growth.
(7) The system is too costly for ordinary farm crops.

The soil involved in the experiments appears to have been a sandy loam of less than 18 ins. depth, with an open gravelly soil below.

From June to September, 1893, investigations regarding the duty, waste and available supply of water were made by Mr. Samuel Fortier, Engineer of the station. The results of this investigation are also included in the above-named bulletin. The principal facts regarding the duty of water on the basis of a 100 days' irrigation period, are summarized as follows, the column of areas of various crops and number of waterings having been added for this article:

Area, acres	Crop.	No. of waterings.	Depth of water, ft.*	Duty, acres per second-foot.	Produce per acre.
0.61	Strawberries....	8	0.45	566	.....
1.65	"	12	2.30	93	300 cases
0.12	Cauliflower	6	0.69	291	7.5 tons
2.5	Tomatoes.....	12	2.07	97	10.0 "
4.7	Mixed crop†....	..	1.92	103	.....
2.26	Barley.....	2	0.60	330	55.3 bu.
4.04	Corn	3	0.31	660	30.0 "
1.18	Potatoes..	7	1.39	143	422.0 "
1.79	Onions.....	9	2.96	67	19.5 "
1.73	Peaches....	13	1.00	213	.....
	Means..... ...	9	1.37	256	.....

* Including slight rainfall. † Alfalfa, squash, peaches, plums, grapes, cherries.

Regarding the waste or loss of water in transmission, observations on five canals show a loss varying from 6.7 to 44% of the total flow. The lowest loss occurred in five miles of canal with a flow at the head gates of 71.2 sec.-ft., the theoretical carrying capacity being 1,000 sec.-ft. The greatest loss occurred in 7,000 ft. of another canal having a flow of 48 sec.-ft. at the head gates. Some stream gagings showed still higher losses, as would be expected.

Tables of gagings of Utah streams close Mr. Fortier's paper.

THE STUDENTS OF THE INSTITUTION OF CIVIL ENGINEERS.

The Council of the Institution of Civil Engineers has issued amended regulations fixing the requirements for admission to the student grade of membership in the institution. According to the by-laws of 1885, the student must be over 18 years of age and under 25 years, and his connection with the institution ceases at the age of 26, unless he has been meanwhile transferred to a higher grade. By these amended regulations he must produce evidence of a competent knowledge of the following subjects: English grammar, composition, history and geography; the elements of mathematics, including quadratic equations and the first three books of Euclid; and, finally, he must have some knowledge of two of the following subjects, not more than one of which shall be a language: Latin, Greek, French, German, Italian, Spanish, elementary mechanics of solids and fluids, elementary geology, elementary physics, geometrical drawing, elementary heat, electricity or magnetism. The institution will accept as evidence of this knowledge any degree in arts, sciences or engineering in any university in the British Empire and qualifying examinations in a long list of educational institutions given in the

regulations. The council especially expresses the hope that no corporate member of the institution will admit to his office as a pupil or apprentice in engineering any one failing to possess the limited qualifications set forth.

In 1891, the last list at hand, the Institution of Civil Engineers had 898 student members out of a total membership of 6,085; the several other active grades standing as follows: Members, 1,749; associate members, 3,019; associates, 409. In some respects this student grade corresponds with the junior member of the American Society of Civil Engineers. The junior must not be under 18 years of age, and his connection with the society ceases at the age of 30 years, unless he shall be previously transferred to another grade. Graduation from a recognized school of engineering, or at least two years' active practice in some branch of engineering, is the requirement for admission to this grade. In 1892, out of 1,636 members of all grades, the American Society of Civil Engineers had 236 juniors, the percentage of total membership being nearly the same as for the students of the Institution of Civil Engineers.

Both of these minor grades are of recent origin and serve as a recruiting ground for the higher grades of membership. By interesting young engineers in the future of the institution at the very outset of their professional career, by bringing them into contact with the older engineers and by encouraging them by students' meetings for the reading and discussion of engineering papers, the Institution of Civil Engineers has done much toward increasing its membership and broadening engineering knowledge generally.

WEATHER TABLE FOR JANUARY, 1894. [Furnished to Engineering News by the Department of Agriculture.]

	Stations.	Temperature. (Deg. Fahr.) Average	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average	Max.	Direction at time of max. velocity.	Precipitation — rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	17.6	51	— 8	59	9.6	42	N	2.56	0.63	13
	Portland, Me.	22.2	46	— 8	54	7.9	38	NW	3.13	1.15	12
	New York, N. Y.	34.6	58	17	41	10.8	43	NW	2.70	1.11	17
	Pittsburg, Pa.	37.2	60	10	50	7.4	28	W	2.02	0.50	11
	Chicago, Ill.	27.5	60	— 9	69	19.0	51	S	1.55	0.64	8
	Omaha, Neb.	20.6	61	—22	83	7.9	26	NW	0.51	0.20	7
	St. Paul, Minn.	10.2	43	—25	68	6.9	32	W	1.04	0.33	10
	Duluth, Minn.	12.6	51	—24	75	6.2	32	NW	1.51	0.24	14
	Bismarck, N. Dak.	3.2	45	—33	78	6.4	48	NW	0.30	0.11	2
	Average	20.6	53	—11	64	9.1	38		1.69	0.55	10
Southern Cities.	Washington, D. C.	37.8	58	17	41	6.4	46	NW	2.14	1.06	14
	Louisville, Ky.	30.8	69	— 5	74	8.8	58	SW	2.81	0.96	11
	St. Louis, Mo.	35.5	72	—11	83	11.8	40	SE	2.56	1.63	6
	Savannah, Ga.	54.0	78	32	46	8.3	26	NE	0.86	0.25	11
	Kansas City, Mo.	29.6	67	—15	82	9.5	35	NW	1.67	1.48	5
	Jacksonville, Fla.	58.6	79	36	43	6.3	27	W	2.29	1.28	9
	Chattanooga, Tenn.	45.6	70	15	55	6.7	40	SE	4.63	0.91	15
	New Orleans, La.	58.0	79	28	51	9.0	30	NW	1.76	0.67	9
	Memphis, Tenn.	46.9	72	2	70	7.7	37	SE	4.03	1.37	11
	Palestine, Tex.	51.1	79	4	75	6.4	29	W	2.28	0.82	7
	Average	45.6	72	10	62	8.1	35		2 50	1.04	10
Western Cities.	Helena, Mont.	18.7	52	—26	78	6.5	45	SW	1.64	0.59	15
	Port Angeles, Wash.	37.2	55	23	32	5.0	24	SW	5.37	1.65	24
	San Francisco, Cal.	47.7	58	36	22	8.0	36	SE	5.99	2.61	14
	Salt Lake City, Utah.	29.0	50	— 1	51	5.6	38	S	1.31	0.33	17
	Santa Fé, N. Mex.	27.8	51	3	48	7.0	32	NW	0.23	0.10	3
	Denver, Colo.	31.4	66	— 7	73	8.9	40	NW	0.18	0.10	3
	Yuma, Ariz.	51.7	74	28	46	7.5	38	N	0.00	0.00	0
	Average	34.8	58	8	50	6.9	36		2.10	0.77	11

CONSTRUCTION NEWS.

(Readers are invited to contribute items concerning new construction of interest to engineers or contractors for insertion in these columns. Those using these pages for information are informed that announcements of calls for proposals are inserted but once, and are not repeated from week to week.)

RAILWAYS.

East of Chicago—Existing Roads.

PENNSYLVANIA.—At a meeting at Denton, Md., last week, the free right of way through the county was guaranteed for the proposed Greensboro and Federalsburg railway.——The bill authorizing this company to build the Elkton, Massey's & Middletown road has been favorably reported by the committee and passed by the house, at Annapolis, Md. The bill provides that the construction of the road be commenced within 90 days from the passage of the act and be completed to Cecilton within 12 months and in operation its entire length within two years, or else the state appropriation of $58,000 for the road shall go to the proposed Elkton & Southern, recently incorporated to build a railway through this same territory.

SOUTH JERSEY.—Logan M. Bullitt, Vice-Pres., is reported as stating that the Bethlehem Iron Co. will begin the delivery this week of 70-lb. steel rails for the extension of this railway to Cape May, and that the road will be completed at an early date. The road will have new equipment throughout.

WILKES BARRE & EASTERN.—It is reported that an extension will soon be built from the main line above Mill Creek, Pa., to the Erie & Wyoming Valley, to reach mines of the Pennsylvania Coal Co.

Projects and Surveys.

BEAVER MEADOW, TRESCKOW & NEW BOSTON.—Incorporated in Pennsylvania to build a railway for passenger and freight traffic between New Boston and Beaver Meadows, Pa.; capital stock, $200,000. Pres., A. S. Van Wickle, Hazleton, Pa.

Southern—Existing Roads.

DRY FORK.—It is stated that 25 miles have been graded on this railway, which is being built from a connection with the West Virginia Central & Pittsburg, at Hendricks, W. Va., to the headwaters of Dry Fork River, by way of the Cheat River Valley. About 200 men are at work on the line, and the work is being pushed rapidly. It is expected to have the ties and rails down as far as Harmon, which is nearly half way on the line, by the middle of March, and to have trains running that far a few weeks later and have the entire line completed in three months.

GLADEVILLE.—The grading on this short railway, near Gladeville, Va., is reported as about completed, and it is stated that contracts will soon be awarded for the rails and equipment. Pres., E. M. Fulton. Wise Court House, Va.

SAVANNAH & ATLANTIC.—H. M. Comer, Receiver, has received bids for rebuilding this road, to cost about $35,000, but the work cannot be done unless the receivers' certificates authorized for this work can be negotiated.

TENNESSEE CENTRAL.—In addition to the letters published Feb. 1 and 15 concerning this railway we have received the following: This road is an extension of the Nashville & Knoxville from Monterey, Putman Co., Tenn., to Harriman, in Rome Co., with a branch to Kingston. The main line will be extended from Harriman to Knoxville at an early day. The surveying corps is now within seven miles of Rockwood, where a connection will be made with the Cincinnati Southern. At Harriman the line will connect with the Knoxville branch. Maj. J. H. Connor & Co. have the contract for building the entire road, including the locating of the line, the grading, bridging, masonry, tracklaying, building of the stations along the line and of all water tanks. The work will require one tunnel 1,600 ft. in length and several large bridges. The first 10 miles is completed. About 200 men are now at work on the line and preparations are being made to increase the force to 500. It is generally understood that Major Connor has a contract with the Tennessee Iron & Coal Co. for the convicts for 21 months.

Projects and Surveys.

GLENN SPRINGS.—H. S. Simpson, Pres., Glenn Springs, S. C., is reported as ready to purchase about 10 miles of 56, 60 or 70-lb. steel rails and equipment for this road.

SOUTH BRUNSWICK TERMINAL.—Maj. John F. Degnon, Ch. Engr., is reported as having made a personal inspection last week of this proposed railway from Atlanta to Brunswick, Ga., with several parties representing English and northern capitalists.

WHITE DAY LAND & TRANSPORTATION.—Porter Haskell, Clarion, Pa., and Wm. McGee and Michael Boice, Pittsburg, are said to have made surveys for this proposed railway from Irontown, on the Baltimore & Ohio, to Opekiska, W. Va., a distance of about 22 miles.

Northwest—Existing Roads.

AHNAPEE & WESTERN.—Work on this railway in Wisconsin is reported as being pushed as rapidly as possible. Pres., E. Decker, Ahnapee, Wis.

BRAINERD & NORTHERN MINNESOTA.—The Minneapolis "Tribune" states as follows: It is proposed to make this railway part of a new system which shall extend from this city north, passing through the counties of Chicago, Isanti, Sherburne, Mille Lacs, touching Mille Lacs Lake, and thence direct to Brainerd to connect with the road already built. The present road is constructed nearly to Leech Lake, and is now operated 40 miles north from Brainerd. Heretofore the plan, as far as Governor Pillsbury has been concerned, was to run west of Leech Lake, and thence pass into the grain country, running west and south of Red Lake. It is now proposed to turn to the east side of Leech Lake, and run to Grand Rapids, the county seat of Itasca county, and thence northeasterly to the Rainy Lake gold fields. Several of the counties have notified the projectors that local aid will be given. Itasca county is said to offer $100,000 for the road.

CHICAGO & NORTHWESTERN.—A press report states that surveyors of this company are running a line from five miles north of Fort Howard, Wis., east to the shore line of the Green Bay road, and that the proposed extension includes 700 ft. of trestle work into the bay, to cost about $30,000.

DULUTH & WINNIPEG.—The senate committee has reported favorably the bill granting this company the right of way across the White Earth and Red Lake reservations in northern Minnesota.

NORTHWESTERN COAL.—Preparations are being made at Superior, Wis., according to reports, for the extension of this road, the work of grading to be commenced as soon as the weather will permit. Several timber trestles will be required. Ch. Engr., C. J. A. Morris, St. Paul, Minn.

RICE LAKE, DALLAS & MENOMINEE.—It is reported that the construction of this railway in Wisconsin will be pushed in the spring and that it is hoped to have the line completed to Dallas, Wis., by July 4.

Projects and Surveys.

ALLOUEZ BAY.—Incorporated in Wisconsin to construct a railway eight miles long around the southern border of Allouez Bay; capital stock, $100,000; F. B. Clark, St. Paul; T. W. Shackleford, F. O. Taylor, G. N. Foresman and E. B. Manwaring, Superior, Wis.

CHICAGO, PADUCAH & MEMPHIS.—Press reports state that the route for this road is being selected and that a contract for construction has been awarded to Johnston Bros. & Faught, St. Elmo, Ill. Ch. Engr., T. P. Reed, St. Elmo, Ill.

EASTERN NEBRASKA & GULF.—It is reported that arrangements are being made to commence this week the survey for the first 50 miles of this road, noted Feb. 8. Ch. Engr., T. W. Kimball, Austin, Minn.

ST. CLAIR, MADISON & ST. LOUIS BELT LINE.—A press report states as follows: The final survey for this road has been completed and it is expected that the construction will be commenced within 30 days. The road radiates from the river, passing through the center of Ridge Prairie, where it intersects the St. Louis & Eastern at Montgomery Station, crosses the Wabash Eastern main line a little southwest of Edwardsville and the branch at Wanda, entering Alton by way of Wann, where it will intersect the main line of the Big Four. The road is expected to be ready for traffic soon after the opening of the Alton and Bellefontaine bridges.

WISCONSIN & MICHIGAN.—A press dispatch from Marinette, Wis., states that the route of this proposed road has been definitely located as follows: Commencing at a point on the Soo road running south to the northern extremity of the Ingalls & Mute Rapids, and using that road for a length of 30 miles; from the southern extremity of this road running south to Potterfield, on the St. Paul road; thence making use of the St. Paul road already built to the terminal point at Marinette. From Porterfield the Wisconsin & Michigan company will extend its line south a distance of six miles to the village of Peshtigo.

Southwest—Existing Roads.

ATCHISON, TOPEKA & SANTA FE.—It is reported that a branch line is being surveyed from Hillsboro to Lake Valley, N. Mex., and that the road will probably be built at an early date to develop the newly discovered goldfields.

HUTCHISON & SOUTHERN.—A press report states that two men have been at work on the proposed extension across the Cherokee strip this winter, but that it is hoped to commence the construction in earnest in the spring. The charter required that work on the line be commenced before last September, and about eight miles were graded in August, when the financial stringency compelled a reduction of the working force.

INTERNATIONAL & GREAT NORTHERN.—New 70-lb. steel rails are being laid on the line between Troupe and Longview, Tex., which will make 80 miles of these rails now laid, according to reports.

LOUISIANA, ARKANSAS & MISSOURI.—It is reported that arrangements are being made to resume the construction of this road. The line is now in operation from Trippe to Mason Lake, Ark., 15 miles, and it is hoped to complete the road to Bryan City, La., 105 miles south of Mason Lake, this year. Gen. Man., H. A. Fisher, St. Louis.

MISSOURI PACIFIC.—The Mosca, Colo., "Herald" publishes a map prepared by J. R. Patterson, Engr., of that city, showing the route for a proposed extension of this railway from Pueblo to Creede by way of Mosca.

ST. LOUIS & SAN FRANCISCO.—Surveys have been made for an extension from Ozark, Mo., to Little Rock, according to reports. Ch. Engr., C. I. Brown, St. Louis.

Projects and Surveys.

GULF & INTERSTATE.—H. E. Stoddard, Pres., Omaha, is reported as stating at a meeting of the executive board at Wichita, Kan., Feb. 22, that enough money is already in sight to build 200 miles of this projected North and South road, and that actual construction will be commenced at Port Bolivar, Tex., within two weeks. A. C. Titus, Ottawa, Kan., is said to have charge of the surveying party, and C. J. Jones, Perry, Okla., to be at the head of the construction company that will build the road.

KANSAS, OKLAHOMA & TEXAS.—The incorporation of this company to build 950 miles of railway was noted in our issue of Feb. 8. Press reports state that W. S. Nelson, Kansas City, Mo., was to go to Arkansas City, Kan., this week to arrange for starting a surveying party to locate the line of the proposed road.

LAKE SUPERIOR, SOUTHWESTERN & GULF.—L. S. Steadman, Ch. Engr., is reported as making surveys

for this road, noted Dec. 14 and 21, and it is stated that the contract for constructing the line between Little Rock and Aurora, Mo., has been awarded to Rosenfield Bros., Omaha, Neb.

RED RIVER & SOUTHWESTERN.—It is stated that a syndicate is being formed to construct this proposed railway. Address W. A. Squires, Henrietta, Tex.

SAN ANTONIO & GULF SHORE.—Press reports state that about one-half of the necessary $100,000 has already been raised at San Antonio, Tex., and that the contract for constructing the first 30 miles of the road will be awarded as soon as the full amount is raised. The surveying corps has reached Yoakum.

WESTPORT & WALDO.—Incorporated in Missouri to build a railway from Kansas City to Waldo Park, in Jackson county, a distance of eight miles; capital stock, $200,000; Lee K. Mooney, Westport, Mo., and W. E. Winner, C. B. Adams, E. S. Young and George Law, of Kansas City.

Rocky Mt. and Pacific—Existing Roads.

BUTTE, ANACONDA & PACIFIC.—Montana papers state that this railway is to be extended from Anaconda, Mont., probably through Skalkaho canyon into the Bitter Root county, and that about 70 miles of road may be constructed this year.

CANADIAN PACIFIC.—A press report from Spokane, Wash., states as follows: It is reported here that the Canadian Pacific has let a contract for the building of 250 miles of railway between Nelson, B. C., and a point near Calgary. The proposed route is the much talked of Crow's Nest Pass and cut-off of the Canadian Pacific. If continued it will again reach the main line at or near Revelstoke. This would give Spokane an all-rail connection with the Canadian Pacific system now being completed to Nelson.

DENVER & RIO GRANDE.—This road is to be changed to standard gage from La Veta to Creede, Colo., according to reports, and a tunnel cut through a portion of the La Veta Pass to shorten the line.

SAN DIEGO, YUMA & PHOENIX.—Officials of this company are reported as stating that for 90 miles west of Yuma, Ariz., the grade of the line will in no case exceed 20 ft. to the mile.

Projects and Surveys.

UTAH & LOS ANGELES AIR LINE.—Incorporated in Colorado to construct a railway from Salt Lake City, Utah, to Los Angeles, Cal., connecting with the Nevada Southern and perhaps with the Atlantic & Pacific; capital stock, $100,000; Capt. Chas. Foxwell, G. A. Evans, B. C. Hicks, A. B. Smith and O. F. Avery, all of New York.

Foreign.

MONTHREY & MEXICAN GULF.—Press reports state that this railway will be immediately extended to the mining camp of Sierra Mojada from Trevino Station, in order to shut out the Mexican International from that place as much as possible. Construction on the extension of the latter road has been temporarily suspended.

STREET AND ELECTRIC RAILWAYS.

WEST BRIDGEWATER, MASS.—A franchise has been granted to the Brockton St. Ry. Co., and it is stated that the proposed belt road connecting the towns of West Bridgewater, Bridgewater and East Bridgewater with Brockton seems now to be a sure thing.

PLAINVILLE, CONN.—The proposition of the New Britain Electric St. Ry. Co. to extend its line to this town has been accepted, the work to be completed in April.

BRIDGETON, N. J.—A franchise has been granted to the Bridgeton, Cedarville & Port Norris Ry. Co.

NEWARK, N. J.—The Newark & South Orange Ry. Co. has had surveys and plans drawn for its proposed extension to Newark Bay.

HAZLETON, PA.—The Lehigh Traction Co. completed eleven miles of track in 1893 and has recently awarded to the Wakefield Electrical Engineering Co., Philadelphia, the contract for its proposed extension from Harleigh to Freeland, a distance of six miles, to be completed by June 15, 1894. Engr., A. E. Hess, Hazleton.

MUHLENBURG, PA.—The citizens have voted to grant the right of way for an electric railway in the township.

PUGHTOWN, PA.—Press reports state that the motive force of the Delaware River & Lancaster R. R. will be changed from steam to electricity and that plans are being considered for several miles of extensions.

SHAMOKIN, PA.—The Shamokin & Bear Valley Electric Ry. Co. has been incorporated; capital stock, $100,000; Pres., E. C. Hamilton.

CENTREVILLE, MD.—The Baltimore "Sun" states that I. B. Brown, W. W. Busteed, Wm. Emory, of Centreville, and R. C. Davidson and others of Baltimore, propose to organize a company to construct an electric railway through Queen Anne's County; capital stock, $500,000.

MERIDIAN, MISS.—It is reported probable that the company securing the electric light contract will construct an electric railway in this city.

CLEVELAND, O.—The "Leader" states that plans are assuming definite shape for a new suburban electric railway from this city to Chardon, Bass Lake and Huntsburg.

TOLEDO, O.—J. A. Dawson, promoter of the Toledo, Monroe & Detroit Electric R. R., is reported as stating that the company will be incorporated this week, and that sufficient money has been subscribed to build the road. Surveyors will make a final trip over the line on March 1, and tracklaying will follow at once. The road will be 60 miles long, and transfer arrangements will be made with local lines in both this city and Detroit.

PERRYSBURG, O.—The Toledo, Maumee & Perrysburg Electric Ry. Co. has been incorporated by J. K. Tillotson and others of Toledo to construct an electric railway between Toledo and this city; capital stock, $150,000. The Bowling Green "Sentinel" says of the project: The survey has been completed and contracts for the cars, ties and rails are being made. All contracts for material will be closed within a few days. Grading on the road will be commenced as soon as the weather will permit. Complete arrangements are made for the money to construct the road, and the first payment has been advanced.

MARION, IND.—The Marion & Gas City Electric Ry. is to be extended to Fairmount, according to reports.

KANSAS CITY, MO.—The Kansas City Electric Ry. Co. has voted to increase its capital to $200,000.

REDLANDS, CAL.—It is reported that the Redlands Electric Light & Power Co. has sold $40,000 of stock to change the motive power of the street railway to electricity.

SOUTH BEND, WASH.—This place will soon have a street railway, according to reports.

HAMILTON, ONT.—The Hamilton Radial Electric St. Ry. Co. has petitioned for power to amend its charter in order to make important changes and extensions. The capital stock is to be increased from $1,000,000 to $2,000,000.

ELEVATED RAILWAYS.

MINNEAPOLIS, MINN.—The "Progress" states local capitalists are said to be figuring upon the construction of an elevated electric railway between this city and St. Paul, using the Cook patent, capable of a speed of 200 miles an hour.

HIGHWAYS.

PENNSYLVANIA.—The citizens of Willistown township, Chester county, have voted to spend $40,000 for macadamized roads. Wilmer Cox and Stephen Beidler, Supervisors.

MARYLAND.—It is reported that the Rockville & Bethesda Turnpike Co. will soon commence the construction of its proposed road, noted Feb. 15.

ALABAMA.—The citizens of Jackson county are discussing the construction of a macadamized road from the state line to the Memphis & Charleston R. R., a distance of 40 miles.

MISSOURI.—Bids are asked until March 7 for grading and macadamizing Blue Ave. from Blue River to the west limits of Independence, Jackson county. F. J. O'Flaherty, Co. Surv., Independence.

WASHINGTON.—It is reported that bonds for $25,000 have been sold to build a road from Buckley, Pierce county, to the logging camps.——The Stillaguamish & Sultan Mining Co. proposes to build a road from Sultan City, Snohomish county, to its lands in the Sultan Basin, according to reports. It is also stated that the settlers in township 26, ten miles south of Sultan, are planning to build a road to that city.

BRIDGES AND TUNNELS.

HARTFORD, CONN.—The city surveyor has reported that a proposed new bridge to replace a wooden one in Asylum Ave. will cost $17,000.

NEW YORK, N. Y.—Bids are asked until March 8 for timber, trestle work and temporary bridge trusses on Park Ave., requiring about 2,000,000 ft. B. M. of timber and 400 tons of ironwork, as stated in our advertising columns.

NIAGARA FALLS, N. Y.—A bill has been introduced in the state senate incorporating the Niagara Falls Park Bridge Co. with power to construct two bridges across the Niagara River; capital stock, $400,000; W. J. West and W. H. Cornell, of this city, and Chas. Fell, J. M. Brinker and C. B. Hill, of Buffalo, are named as bridge commissioners, though the company is said to be composed chiefly of those interested in the electric railway companies running on the Canadian side to Queenstown.

OGDENSBURG, N. Y.—It is stated that $55,000 has been appropriated for a new bridge across the Oswegatchie River at this place.

TROY, N. Y.—Bids are asked until March 9 for constructing the abutments and wing walls, also for the steel superstructure of the Spring Ave. bridge over the Poestenkill. E. Ogden Ross, Secy.

MILTON, PA.—It is reported that bids are asked until March 16 for constructing a county bridge across the Susquehanna River between this place and West Milton.

SCRANTON, PA.—Edward F. Blewitt, Ex-Cy. Engr., writes us that the city has voted by over 2,000 majority in favor of the steel bridges over Linden St., 600 ft. long, and over Roaring Brook, 900 ft. long; plans already prepared; estimated cost, $250,000.

MACK, ALA.—J. A. Dickinson is said to want prices on iron bridges.

TUSKALOOSA, ALA.—J. H. Whitner, Knoxville, Tenn., has been awarded contracts for two $5,000 steel bridges in this county, according to reports.

COLUMBUS, O.—Bids are asked until March 23 for constructing a two-span riveted plate girder bridge over Alum Creek, Marion township, and until March 26 for a bridge over Alum Creek, Mifflin township. Henry J. Carens, Co. Aud.

CHICAGO, ILL.—Plans have been prepared by the Metropolitan Elevated R. R. Co. for a new bridge across the river between Van Buren and Jackson Sts. The bridge will be similar to the one being erected by city at Van Buren St.; estimated cost, $150,000.

GREEN BAY, WIS.—X. Parmentier, Cy. Clk., writes us that the bids for the proposed bridge, recently noted, were all rejected, being above the appropriation of the council for the work.

HELENA, MONT.—The following bids were received by the commissioners of Lewis, Teton and Clarke counties for the construction of an iron or steel bridge across the north fork of the Sun River: S. M. Hewett & Co., $7,587; Bullen Bridge Co., $7,700; Wrought Iron Bridge Co., $7,000 to $7,700; Gillette-Herzog Mfg. Co., $7,497; King Bridge Co., $7,990; Geo. K. Reeder, $8,411; H. L. Cooper, $7,600; Wisconsin Bridge & Iron Co., with ¼-in. tubes, $7,222; with ⅜-in. tubes, $8,600; M. S. Parker, $7,695; Massillon Bridge Co., $7,395 to $7,460; Milwaukee Bridge & Iron Co., $7,425; O. E. Peppard, $6,259 to $6,610.

JEFFERSON CITY, MO.—The Jefferson City Bridge & Transit Co. has engaged J. A. L. Waddell, Kansas City, as chief engineer of its proposed highway and motor bridge over the Missouri River at this place. Mr. Waddell is now engaged in making borings on which to base preliminary designs and estimates.

BARSTOW, TEX.—Bids are asked until March 19 for an iron bridge, 90 ft. span and 14 ft. wide, across the Pecos River about 35 miles southeast of this city. A. W. Williams, Judge, Pecos Co.

COLUMBIA, TEX.—Bids are asked until March 15 for the construction of an iron and steel bridge across the Brazos River at this place. R. E. Duff, Secy. Com.

TACOMA, WASH.—The following bids were received Feb. 19 for the proposed Eleventh St. bridge: Missouri Valley Bridge & Iron Wks., $89,945; with hand rail, $91,545; with steel joists under railroad track, $94,445; with steel joists throughout, $101,445; King Bridge Co., $93,000; Bullen Bridge Co., $102,000; Hoffman & Bates, $96,000; Pacific Bridge Co., $98,000; H. Krust (payment valid 5% bonds), $94,000; Pennsylvania Bridge Co., $90,800; Puget Sound Dry Dock Co., $98,000; Chas. A. Syre, $103,463.

LONDON, ONT.—The county council is reported to have ordered that plans be prepared at once and bids asked for a bridge at Kilworth.

FREDERICTON, N. B.—The contract for the superstructure of the Woodstock bridge has been awarded to the Canada Bridge Co., at $42,500, according to press reports.

WATER-WORKS.

BARTON LANDING, VT.—It is reported that a gravity system will be put in.

ST. JOHNSBURY, VT.—Arthur F. Stone, Vil. Clk., writes us that the St. Johnsbury Aqueduct Co. has made a proposition to put in a $150,000 plant and the question will be considered at a meeting March 5.

ABINGTON, MASS.—A. H. Wright, Supt., writes us that a 2,500,000-gallon pump will be purchased if the town and the town of Rockland provide the means at the coming annual meetings.

BRADFORD, MASS.—The question of purchasing the private works is expected to be considered at the town meeting March 20.

BROCKTON, MASS.—Work will be commenced on the Monticello extension as soon as the frost is out of the ground. Some of the 24-in. pipe has been shipped; estimated cost, $70,000.

CHESTER, MASS.—It is stated that no objection will be made to this town securing the proposed supply from streams in Becket.

DANVERS, MASS.—Henry Newhall, Registrar, writes us that the town is considering the question of a standpipe, but that no definite steps have been taken.

EVERETT, MASS.—It is proposed to appropriate $30,000 for extensions.

HUDSON, MASS.—It is reported that the town will be asked to appropiate $25,000 for a new storage reservoir, at the March meeting.

IPSWICH, MASS.—The legislative act giving authority to put in works has been adopted by the town by a vote of 472 to 78.

MONSON, MASS.—R. M. Reynolds and A. D. Norcross are members of a committee appointed to investigate the question of works.

PITTSFIELD, MASS.—The board of public works has recommended that the dam at Ashly Lake be raised from 2 to 4 ft.; estimated cost, $23,000.

SOUTH DEERFIELD, MASS.—It is stated that a company has been organized to put in works; capital stock, $50,000.

WESTFIELD, MASS.—The commissioners are reported as about to recommend that Shatterack Pond be taken as an additional supply.

WALTHAM, MASS.—The commissioners have asked for an appropriation of $10,000 for extensions.

GROTON, CONN.—Press reports state that outside parties are considering the construction of a system at this place; estimated cost, $60,000.

WATERBURY, CONN.—Bids are asked until March 9 for constructing section 2 of the 36-in. cast iron conduit, as stated in our advertising columns. The total bids recently received for this work were published last week. R. A. Cairns, Cy. Engr.

ALFRED CENTER, N. Y.—It is reported that the citizens have voted to secure a gravity supply.

FORESTVILLE, N. Y.—Walter Record, Vil. Clk., writes us that it is probable that works will be put in, but that no definite steps have been taken. Address L. J. Pierce.

MIDDLETOWN, N. Y.—E. M. Hamilton, Cy. Clk., writes us concerning proposed extensions that preliminary surveys have been made for a gravity supply but no plans have yet been prepared.

NEW YORK, N. Y.—The department of public works will receive bids until March 6 for laying mains in about 12 streets.

ROSENDALE, N. Y.—The Rosendale Water-Works Co. has been incorporated by Warren Sammons, J. E. Hardenburgh, W. B. Snyder and others; capital stock, $25,000.

NORTH TONAWANDA, N. Y.—The citizens have voted to purchase the works.

CAMDEN, N. J.—The citizens are considering several plans for a new supply, which must be secured at once, as noted last week.

DECKERTOWN, N. J.—It is stated that ballots are being distributed to secure an expression of the taxpayers on the question of works previous to the March meeting.

RUTHERFORD, N. J.—An election will be held in Rolling Springs township March 6 to vote on incorporation as a borough. It is stated that the citizens wish to secure water-works and sewers.

BEAVER FALLS, PA.—Harry T. Barker, Cy. Engr., writes us that the citizens have voted $125,000 for constructing new works, but that no decisive action has been taken as to details of construction.

MAUCH CHUNK, PA.—Press reports state that a private company will erect a plant here, at a cost of $20,000.

INDIANA, PA.—H. M. Bell, Man. Clymer Water Co., writes us that the amount of extensions will be decided upon at the annual meeting March 26.

LEBANON, PA.—The council is considering an ordinance appropriating $1,000 for the employing of an engineer to prepare plans for an additional supply.

MAHANOY CITY, PA.—We are informed that the proposed project was voted down.

TYRONE, PA.—C. H. Dieffenbargh, Supt., writes us that the water company is considering the advisability of building a dam the coming season, but that no plans have been prepared.

BERRYVILLE, VA.—Geo. C. Thomas, Pres. Berryville Water Co., writes us as follows: We would like some responsible party to come and look over what work we have done and make us a proposition for completing it. We have purchased 100 acres of land abounding in springs and all the r ght of way. We have spent about $23,000 and have some $21,000 of unsold bonds.

MARTINSVILLE, VA.—The city has sold $27,000 of 6% bonds and has contracted with H. A. Gillespie, Pres. Virginia Const'n & Paving Co., for the construction of works to cost $27,000, works to be completed within 90 days.

NORTH DANVILLE, VA.—The town is reported as about to petition for authority to construct works.

PETERSBURG, VA.—The city has sold $7,500 of the 40-year 5% water and improvement bonds at $106.

AIKEN, S. C.—The citizens have voted, 108 to 3, in favor of works, and it is stated that bids will soon be received for the construction.

NEWNAN, GA.—We are informed that the city is not yet ready to receive bids for the stand-pipe for which plans are being prepared, as stated last week.

ROME, GA.—The council of East Rome is negotiating with the city for a supply, according to reports.

OCALA, FLA.—It is proposed to extend the works to Silver Springs Park.

BIRMINGHAM, ALA.—Press reports state that the city has purchased all the property of the water company for $1,400,000; the city to assume $600,000 of 6% 30-year bonds issued by the company and the balance to be payable in 5½% 30-year bonds to be issued by the city.

MERIDIAN, MISS.—The city is reported to have petitioned for authority to issue bonds to purchase or construct works.

WATER VALLEY, MISS.—C. R. Cock, Mayor, writes us that there is talk of works, but that it will be some time before they are secured.

ALEXANDRIA, TENN.—It is stated that Ray & Jones may be addressed concerning proposed works at this place.

BROWNSVILLE, TENN.—We are informed that the citizens wish to grant a franchise.

GREENVILLE, TENN.—The town council is considering the question of works for fire protection.

MOUNT STERLING, KY.—It is reported that 17 acres have been purchased for a reservoir for proposed works.

CLEVELAND, O.—The board of control has recommended that the contract for pipe be awarded to J. B. Clow & Co., Chicago. The prices are published under Contract Prices.

GARRETTSVILLE, O.—F. M. Barber, Mayor, writes us that the city expects to put in a pump to be operated by the electric light engine to secure fire protection, but that the matter has not been definitely decided. F. F. Mott, Chn. Com.

MANSFIELD, O.—F. M. Remy, Cy. Clk., writes us that the question of issuing $30,000 of bonds for increasing the supply will be voted upon April 2.

MIDDLETOWN, O.—The mains will be extended to East Middletown, the work to commence at once, according to reports.

READING, O.—The trustees are reported to have decided to extend the service to that part of the village formerly called Strausburg.

ST. BERNARD (P. O., Ludlow Grove), O.—The citizens have voted in favor of the proposed issue of bonds for works and an electric light plant.

TOLEDO, O.—It is stated that about 10 miles of extensions will be laid.

ZANESVILLE, O.—The city has sold $25,000 of water improvement bonds.

LAFAYETTE, IND.—The water company has purchased a site for a reservoir and has completed a pumping station ready for the machinery, which will be put in within 60 days, according to reports. Bonds for $30,000 are being negotiated.

LEBANON, IND.—Bids are asked by the council until March 15 for constructing works estimated to cost $55,000.

DETROIT, MICH.—The commissioners have voted to substitute iron for wood pipes in 19 streets.

MARSHALL, MICH.—The citizens have voted to issue $50,000 of bonds for works. The company has been given until March 1 to make a satisfactory proposition for selling its plant to the city.

EDWARDSVILLE, ILL.—The council has accepted the proposition of J. W. Starr, noted Feb. 15, the work to be commenced within 60 days.

BUSHNELL, ILL.—W. S. Shields, Title and Trust Bldg., Chicago, has been engaged to design a system.

LEMONT, ILL.—John A. Graf, Vil. Clk., writes us that it is intended to put in a filter and a stand-pipe 100 ft. high, but the work will not be advertised until after the board meets Feb. 28 to decide about 4,000 ft. of extensions.

MARENGO, ILL.—C. P. Filmore, Cy. Clk., writes us that bids are asked until March 17 for works, including a stand-pipe 70 ft. high, 2,700 ft. of 8-in., 5,950 ft. of 6-in. and 9,450 ft. of 4-in. pipe; supply from shallow well; population, 2,000.

MURPHYSBORO, ILL.—The company has offered to sell the water and electric light plant to the city for $95,000 and the council has offered $75,000.

OTTAWA, ILL.—Only two bids were received for proposed works: W. S. Reed & Co., Chicago, offered to construct system, including 20 × 100 ft. stand-pipe and two 2,000,000-gallon pumps, and sell it to the city at any time for $160,000; E. V. Johnson Co., 18 or 19 miles of mains, 200 hydrants at $10,000 per year and $40 for each additional, artesian supply, stand-pipe, two 1,500,000-gallon pumps, two 500,000-gallon reservoirs, 30-year franchise, sell upon payment of $60,000 as advance hydrant rental; both wish to bond works for $100,000.

PANA, ILL.—A. B. McMillen, Cy. Clk., writes us that the contract for a complete system has been awarded to Chas. A. Stookey, Belleville, at $35,319.——Voorhies & Witmer, Engrs., Buffalo, N. Y., who will superintend the construction, inform us that the council adopted Worthington pumps, Matthews hydrants and Rensselaer valves, and that the Brownell & Co., Dayton, O., will build the steel stand-pipe.

BAYFIELD, WIS.—F. W. Denison, Secy. Bayfield Hydraulic Co., writes us that the company will be ready to award contracts for the proposed reservoir and pumping station as soon as $30,000 to $60,000 of bonds have been sold. Engr., J. T. Fanning, Minneapolis.

ONALASKA, WIS.—It is reported that Harvey Brice has commenced the survey for the proposed works, which will be put in at once.

PLATTEVLLE, WIS.—A. W. Hastings, Cy. Clk., writes us that J. A. Haskell has prepared plans for works, but that owing to the assessed valuation of the city it is unable to issue the bonds necessary to construct the system and that the election notice has been withdrawn and the council wishes to grant a franchise.

REEDSBURG, WIS.—A permanent injunction has been secured to prevent the issue of bonds for proposed works.

RIVER FALLS, WIS.—It is reported that works will be constructed in the spring.

WAUPUN, WIS.—A proposition for works is being considered, according to reports.

BRITT, IA.—The citizens are reported as about to vote on an issue of $8,000 of bonds for works.

GRINNELL, IA.—J. F. Wilson Cy. Clk., writes us that the proposed works, noted last week, will include a 11 × 40 ft. stand-pipe, 40 × 40 × 10-ft. reservoir, about 12,500 ft. 10 to 4-in. iron pipe, 33 hydrants and fire pump.

GRUNDY CENTER, IA.—It is reported that works will be put in.

INDIANOLA, IA.—Edd R. Olive, Cy. Clk., writes us that the citizens seem to favor the question of works and that an election may be held to vote on the question, after which plans may be prepared.

McGREGOR, IA.—Plans are being considered for securing a supply, according to reports.

RED OAK, IA.—An injunction has been granted to prevent the city from issuing $14,000 of bonds for improving the works.

SIBLEY, IA.—Press reports state that the question of works is being agitated.

DULUTH, MINN.—The "Herald" states that the general plans for works have been settled upon, including details for pumping station, intake pipe, mains and reservoir.

FAIRMOUNT, MINN.—It is reported that $20,000 of bonds have been sold for works and electric lights.

SPRINGFIELD, MINN.—Works will be constructed, according to reports.

WASECA, MINN.—The contract for works, noted Feb. 8, has been awarded to Edmund Sykes, Minneapolis, at $28,230.

CREIGHTON, NEB.—The citizens have voted to issue $9,000 of bonds for works.

HASTINGS, NEB.—At an election April 3 the citizens will vote on the question of issuing $10,000 of bonds for extensions.

OSCEOLA, NEB.—A. A. Richardson, Engr., Lincoln, addressed the voters last week on the question of works and it is reported probable that an election will soon be held to vote bonds for the construction.

HIGGINSVILLE, MO.—Chas. F. Sturtevant, Consult. Engr., St. Louis, has been engaged to superintend the construction of works to cost $10,344. The material will be purchased from open market.

RICHMOND, MO.—It is reported that the question of works is being discussed.

WARRENSBURG, MO.—The Warrensburg & Pertle Springs Water-Works Co. has been incorporated by J. H. and Marion Christopher and Wm. P. Hunt; capital stock, $50,000.

AUSTIN, TEX.—The city has sold $150,000 of the city dam bonds, leaving about $180,000 still unsold, and work has been resumed on the new works, according to reports.

BAIRD, TEX.—Bids are asked until March 14 for constructing works. J. E. W. Lane, Mayor.

CLARKSVILLE, TEX.—It is reported probable that works will be put in.

MILANO, TEX.—Press reports state that P. W. Buer, Dallas, is interested in a scheme to lease the supply of the Gulf, Colorado & Santa Fe Ry., two miles distant, and put in works.

SAN SABA, TEX.—A stand-pipe will be erected and larger mains and meters put in, according to reports.

ENID, OKLA.—John C. Moore, Mayor, writes us that specifications have been prepared for works and electric light plant, but no election has yet been called; estimated cost, $55,000, on basis of 10,000 people.

PERRY, OKLA.—Alonzo Wharton, Cy. Clk., writes us that an election was called for Feb. 21 to vote on an issue of bonds for $60,000 for works; population, 10,000.

COLORADO SPRINGS, COLO.—The council has sold $25,000 of 5% water bonds, at $25,010, for the Woodbury water right lately acquired.

DENVER, COLO.—The receiver of the Beaver Brook Water Co. has been authorized to spend $45,000 for improving the plant. It is expected to double the present supply of 1,500,000 gallons.

RATON, N. MEX.—E. S. Williams, Engr., writes us that the Raton Water-Works Co. proposes to relay three or four miles of 3-in. pipe. The company uses only Kalamein pipe with converse lock joints and does its own work under the direction of A. L. Hobbs, Supt.

TACOMA, WASH.—D. B. Ogden has submitted a proposition to furnish a daily supply of 5,000,000 gallons of spring water, delivered at city limits, for $175,000, according to press reports.

DALLAS, ORE.—It is reported that the water bonds recently voted will be sold in April.

PORTLAND, ORE.—The committee has purchased a site for a 20,000,000-gallon low service reservoir for the east side, and it is stated that the contracts for the construction will soon be awarded. Contracts have already been awarded for three reservoirs upon which work will be resumed in earnest as soon as the weather permits.

SAN FRANCISCO, CAL.—The Spring Valley Water Co. has purchased 42 acres of land for a site for its proposed 200,000,000-gallon reservoir.

BROCKVILLE, ONT.—It is stated that improvements, including a stand-pipe, are under consideration.

LINDSAY, ONT.—Steps are being taken to purchase the works for $60,000, according to reports.

WINDSOR, ONT.—The council is considering an appropriation of $10,000 for improvements.

LEVIS, QUE.—It is estimated that works will cost $150,000, according to reports.

YARMOUTH, N. S.—The council has accepted the plans of M. M. Tidd, Boston, for works, including 2,000,000-gallon reservoir, 2,000,000-gallon pumping machinery, 4 to 5 miles of 6-in. and 2½ miles of 12-in. pipe.

ARTESIAN WELLS.

SALEM, N. J.—C. W. Casper, Supt., writes us that the council has voted to sink 11 artesian wells and a receiving cistern in the spring, but that the specifications have not yet been prepared. An experimental 6-in. well 240 ft. deep was put down last fall.

BERTRAND, NEB.—Efforts are being made to secure a supply of artesian water for Perkins county. The Burlington & Missouri R. R. Co. has offered to loan well-boring machinery, according to reports.

RAPID CITY, S. DAK.—It is reported that an election will soon be held in Pennington county to vote on sinking an artesian well, under the state law.

FARGO, N. DAK.—The city auditor has been instructed to ask for bids for sinking an artesian well in Island Park.

GREENVILLE, TEX.—Parties from Fort Worth are reported as negotiating with a view to sinking an artesian well here.

HICO, TEX.—About $2,500 has already been raised toward sinking an artesian well at this place, according to reports.

WEST, TEX.—The West Water-Works Co., recently incorporated, is reported to have contracted with J. B. Fowler, Waco, to sink an artesian well.

IRRIGATION.

ERIE, COLO.—John McCormack is reported to have made surveys for a new ditch from Coal Creek two miles south of this place. It would be ten miles in length and irrigate 1,000 acres.

JULESBURG, COLO.—It is stated that surveys have been made for a large irrigation canal, the Oshkosh, on the lower portion of the North Platte near this place.

ELLENSBURG, WASH.—Press reports state that the directors of the Middle Kittitas Irrigation District will resume work on its canal. The work will cost nearly $200,000 and was stopped two years ago by an injunction.

NEW COMPANIES.—Niobrara River Irrigation & Power Co., O'Neill, Neb.; $2,500,000; to construct a canal 250 miles in length; address J. H. Riggs.——Reeves County Canal Co., Pecos, Tex.; $5,000; W. H. Dodson, G. W. Phillips, C. E. Buckholz.——Harrisburg Water Power Co., Harrisburg, Ore.; $16,000; to bring water from the McKenzie River to Harrisburg for power and irrigation purposes; E. E. Upmeyer, J. G. Senders, W. S. Brown.——Big Creek Reservoir Co., Eagalite, Colo.; $5,000.——Zapato Irrigation Co., Engle, N. Mex.; $100,000; to construct 127 miles of canals from Mitchell's dam, near San Marcial; A .O. Roniller, Philip Mothersill, J. W. Mochell, W. M. Jones.

SEWERS.

RUTLAND, VT.—The citizens will vote on issuing $25,000 of bonds for sewer construction at the next city election.

CLAREMONT, N. H.—It is reported probable that an engineer will be employed to prepare plans for a system.

LOWELL, MASS.—The council has voted to appropriate $50,000 for sewers.

MALDEN, MASS.—Authority is to be asked to issue a second $250,000 of sewer bonds.

MELROSE, MASS.—Bids are asked until March 24 for constructing a section of the new system, as stated in our advertising columns. W. C. Stevens, Cy. Engr.

WEST NEWTON, MASS.—Bids will be asked for constructing about 20,000 ft. of pipe and 7,400 ft. of 24 × 30-in. brick sewers. H. D. Woods, Cy. Engr.

WINCHESTER, MASS.—It is reported that about 6½ miles of sewers will be constructed early in the season, to cost about $170,000.

PROVIDENCE, R. I.—The council has appropriated $118,000 for sewers.

COHOES, N. Y.—The council is discussing the construction of sewers in the central part of the city.

TROY, N. Y.—Bids are asked until March 10 for constructing two brick and six pipe sewers. E. O. Ross, Secy.

WHITESTONE, N. Y.—Bonds for $13,000 have been sold for sewer construction.

EAST ORANGE, N. J.—The contract for the outlet sewer has been awarded to Thos. A. Nevins, at $230,000.

NEW CASTLE, PA.—The city engineer has proposed that sewers be constructed in several streets.

PHILADELPHIA, PA.—Geo. S. Webster, Ch. Bureau of Surveys, reports that there was constructed last year 73.27 miles of sewers, costing about $2,500,000, of which 10.56 miles were main sewers.

SCRANTON, PA.—The city engineer is preparing plans for sewers, estimated to cost about $30,000.

MORGANTOWN, W. VA.—An election will be held March 10 to vote on issuing bonds for $11,000 for sewers.

ATLANTA, GA.—An appropriation of $15,000 has been made for sewers in West End.

OCALA, FLA.—It is reported that the Georgia-Florida Monolithic Sewer Co. has submitted a proposition for building sewers, estimated to cost about $25,000.

VICKSBURG, MISS.—The commercial club is discussing plans for a system; estimated cost, about $40,000.

ASHTABULA, O.—H. E. Mann, Cy. Engr., writes us that he has completed plans for district No. 2, including 5,413 ft. of 20 × 30 ins. to 62-in. brick and 31,365 ft. of 8 to 20-in. pipe sewers; estimated cost, $58,395. A portion of the work will probably be constructed this season.

HAMILTON, O.—It is stated that the plans now being

prepared by Geo. S. Pierson, Kalamazoo, for a system will provide for a pumping station in anticipation of disposing of the sewage at some future time other than by emptying it into the river.

TOLEDO, O.—Bids are asked until March 12 for constructing a 3-ft. brick sewer. Sylvester Lamb, Cy. Clk.

CONNERSVILLE, IND.—J. M. Waldrip, Cy. Clk., informs us that the committee has been directed to procure plans and specifications for a complete system. Wm. Merrell, Chn. Com.

CRAWFORDSVILLE, IND.—The "Journal" urges the council to take steps to secure a system.

ELKHART, IND.—Bids are asked until March 7 for constructing a sewer in Marion St. C. L. Kinney, Cy. Engr.

INDIANAPOLIS, IND.—Bids are asked by the board of public works until March 5 for constructing two sewers.——Bids were received last week as follows for constructing local sewers: Indiana Ave.,—A. Bruner, $1.70 per lin. ft.; Roney & Spaulding, $1.59; E. P. Hannahan, $1.15 (awarded contract); Daniel Foley, $1.25; R. P. Dunning, $2.15; Gansberg & Roney, $1.18; W. C. Allen & Co., $1.33. Tennessee St., 5,575 lin. ft.—A. Bruner, $2.35; Roney & Spaulding, $2.27; Fulmer, Selbert & Co., $2.84; Daniel Foley, $2.15 (awarded contract); Gansberg & Roney, $2.54; Bossert & Waterman, $2.36; A. W. Conduitt, $2.30; W. C. Allen & Co., $2.33.

LEBANON, IND.—The contract for constructing a sewer in the southern section of the city has been awarded to Waugh & Shahan.

RICHMOND, IND.—Bids are asked until March 16 for constructing a 4½ to 4-ft. brick sewer. C. G. Swain, Clk. Bd.

TERRE HAUTE, IND.—Bids are asked until March 6 for constructing eight 15 to 12-in. pipe sewers. C. H. Goodwin, Cy. Clk.

AURORA, ILL.—The contract for constructing a system on the east side has been awarded to the Townsend Brick & Tile Co., Zanesv.l.e, O., at $179,375.

PANA, ILL.—A. B. McMillen, Cy. Clk., writes us that nothing has been done to secure sewers except to make the surveys.

PEORIA, ILL.—Isaac Taylor, St. Comr., writes us that bids will be opened April 1 for constructing 3,000 ft. of 42 to 36-in. brick sewers, average cut 14 ft., and 15 miles of 18 to 8-in. pipe sewers, average cut 15 ft. J. A. Harman, Cy. Engr.

MILWAUKEE, WIS.—Plans and estimates have been made for work this year estimated to cost $235,000.

DULUTH, MINN.—The city engineer has prepared plans for constructing about 15 miles of sewers in the Woodland district.

NEW DULUTH, MINN.—Bids are asked until March 6 for a sewer in one street. J. A. McCuen, Cy. Recorder.

PALESTINE, TEX.—T. J. Dunovan, Lowell, Mass., has been granted a franchise for a system, according to reports.

LOS ANGELES, CAL.—It is reported that the lowest bid for the Maple Ave. sewer was that of Dalton Wheeler. This and the Hill St. sewer, recently awarded to Mr. Young, will cost about $115,000 and the construction of both will be commenced as soon as possible.

OAKLAND, CAL.—The city engineer has been directed to prepare plans for several sewers.

HINTONBURG, ONT.—The building of a sewer, the outlet to be into the Ottawa River, is being discussed.

STREETS.

CLINTON, MASS.—The road department has recommended an appropriation of $20,600 for street improvements and $5,000 for sewers.

MALDEN, MASS.—The council has appropriated $10,000 for brick sidewalks.

ALBANY, N. Y.—The city engineer has been directed to prepare specifications for repaving two streets with granite blocks.

JAMESTOWN, N. Y.—The citizens have voted to issue $125,000 of bonds to pave the principal streets and the work will be commenced as soon as possible. Brick will be used on all but one street, which will be paved with granite blocks.

NEW UTRECHT, N. Y.—Authority has been asked to issue $800,000 of bonds for local improvements.

NEW YORK, N. Y.—Bids are asked by the department of public works until March 6 for paving two streets with granite and one with asphalt.——The department of parks will receive bids within a few days for constructing the second section of the proposed speedway; estimated cost, about $1,175,000.

TROY, N. Y.—Bids are asked until March 10 for paving four streets with brick. E. Ogden Ross, Secy.

CAPE MAY, N. J.—Bids are asked by the street committee until March 6 for paving Washington St., about 3,000 sq. yds.

ELK CITY, W. VA.—It is reported that an election will soon be held to vote on issuing $15,000 of bonds for improvements, including $7,000 for paving.

HUNTINGTON, W. VA.—A temporary injunction has been secured against the proposed sale of $75,000 of street and sewer bonds.

ATLANTA, GA.—The council has voted to improve several streets.——The opening of bids for paving Pryor St. with brick has been postponed until March 19.

SAVANNAH, GA.—It is reported that West Broad St., 20,000 sq. yds., will be paved with Belgian blocks.

OCALA, FLA.—It is proposed to appropriate $25,000 for improvements, including $15,000 for paving.

MONTGOMERY, ALA.—David Floyd, Cy. St. Comr., is preparing specifications for paving several streets. Improvement bonds for $250,000 have been authorized.

OWENSBORO, KY.—It is reported that bonds for $125,000 will be issued for paving streets with brick and building sewers.

CLEVELAND, O.—Bids are asked by the board of control until March 7 for improving eight streets, and until March 21 for paving six streets with Medina stone, five with brick and one with asphalt.

IRONTON, O.—The council has voted to pave Third St. from Pine St. to Ice Creek with brick.

NEWARK, O.—Resolutions have been adopted for paving five streets with brick. W. A. Irvine, Cy. Clk.

EVANSVILLE, IND.—The board of public works is reported to have decided to improve 11 streets, about 30 squares, and it is thought that bids for the work will be received about March 17.

HUNTINGTON, IND.—Bids are asked until March 15 for paving Jefferson St. with brick. H. H. Wagoner, Cy. Engr.

INDIANAPOLIS, IND.—The board of public works has about decided to pave Meriden St. with brick, according to reports.

LAPORTE, IND.—It is reported that the city will pave several streets with brick upon 6 ins. of crushed limestone and 2 ins. of sand.

DETROIT, MICH.—The board of public works has presented a proposition for paving several streets with brick, at a cost of about $200,000.

PEORIA, ILL.—Bids are asked until March 28 for 16,509 sq. yds. of brick paving, as stated in our advertising columns. J. A. Harman, Cy. Engr.

MILWAUKEE, WIS.—The board of public works has recommended that Grand Ave. be paved with asphalt, at a cost of $41,581; also that several streets be graded and graveled.

NEW DULUTH, MINN.—Bids are asked until March 6 for macadamizing Commonwealth Ave. J. A. McCuen, Vil. Recorder.

KANSAS CITY, MO.—H. P. Langworthy, Secy. Bd. Pub. Wks., writes us that bids are asked until March 5 for paving five streets, 31,151 sq. yds., with asphalt, and six streets, 10,640 sq. yds., with brick.

HOUSTON, TEX.—Bids are asked by the city secretary until March 12 for paving one street with brick and for constructing curb walls in four streets.

ELECTRIC LIGHT AND POWER.

BUFFALO, N. Y.—The council is again considering the question of a municipal electric light plant, estimated to cost $100,000. The contracts which expire in 1897 call for 4,754 gas and 1,670 electric lights, and it is stated that 377 additional gas and 195 electric lights are needed.

BEVERLY, N. J.—It is reported that the Cinnamison Electric Lighting Co. has been organized to supply light to this place, Riverside, Delanco, Riverton and Palmyra.

LYNCHBURG, VA.—Carter Glass, Clk., writes us that the city has decided to build an electric light plant.

WOODLAWN, ALA.—An electric light plant will soon be put in, according to reports.

HAMILTON, O.—Bids are asked until March 17 for the construction of an electric light plant. J. J. McMaken, Cy. Clk.

KALAMAZOO, MICH.—Press reports state that the city will procure plans and specifications at once for an electric light plant estimated to cost from $35,000 to $40,000.

CHICAGO, ILL.—The Chicago Edison Co. has voted to increase its capital stock from $3,000,000 to $5,000,000 to complete its Harrison St. plant and for other extensions.——The Wallace Electric Co. has increased its capital stock from $2,000 to $25,000.

MILFORD, ILL.—Bids are asked until March 12 for an electric light plant, according to reports.

RACINE, WIS.—The city clerk has been directed to advertise for bids for street lighting for 1, 3 or 5 years from June 1.

SHEBOYGAN, WIS.—It is reported that the Mattoon Mfg. Co. will add two 400-HP. engines and one 250-HP. boiler to its plant.

DENISON, IA.—A company is reported to have contracted to operate the city water-works for $800 a year and to furnish 20 arc lights of 1,200 c. p. for $1,200 per year.

LEAVENWORTH, KAN.—The council has voted to submit the question of issuing $30,000 of bonds for constructing an electric light plant to the citizens at the April election.

SAN ANTONIO, TEX.—The only bid for a plant complete for 300 arc lights of 2,000 c. p. and 500 incandescent lights of 16 c. p. was that of the Great Western Mfg. Co. and the Western Electric Co., at $63,200, the city to furnish the building.

NEW COMPANIES.—Electrical Mfg. Co. of America, Red Bank, N. J.; $300,000; W. J. Keys, Somerville; W. F. Corlies, Thos. Davis, Jr., and J. F. Bray, Red Bank.——Electric Illuminating & Power Co., Long Island City, N. Y.; $50,000; E. A. Maher, R. T. McCabe, New York; H. H. Hollister, Islip; Cord Meyer, Maspeth.——Alexandria County Light, Water & Power Co., Alexandria, Va.; J. H. Embry, Washington; R. H. Philips, H. H. Wells, Alexandria.—Almonesson Lake Co., Almonesson, N. J.; $100,000; to operate electric plants, etc.; M. McCarron, J. M. Duffy, J. A. Flaherty, all of Philadelphia.——Electric Power & Machinery Co., New York, N. Y.; $100,000; Frank Mansfield, Jersey City, N. J.; C. P. Breese, J. L. Ludwig, New York.——Placerville Electric Co., Auburn, Cal.; $20,000.——Atchison Telephone & Electric Light, Atchison, Kan.; $50,000; B. P. Waggener, W. P. Waggener, David Kelso.——Western Automatic Light Co., Chicago, Ill.; $500,000; Wm. J. Stapleton, Ed. S. Clark, Maud Freeman.——Eastern Electric Light, Heat & Power Co., Southampton, N. Y.; $15,000; to furnish light, heat and power for Suffolk, Queens and Kings counties; John H. Adams, R. B. Roosevelt, Jr., New York, and Frank S. Taintor, Southampton.——Larchmont Arctic Light Co., Larchmont Manor, N. Y.; to supply light, heat and power for the towns of Mamaroneck, Rye and New Rochelle. C. H. Murray, Wm. Murray, Larchmont Manor, and Frank G. Senter, New York.—American Electric Battery Co., Des Moines, Ia.; $250,000.——East Buffalo Electric Co., Buffalo, N. Y.; $1,000; Stephen Churchyard, J. J. Churchyard, A. Simons.—Wisconsin Automatic Light Co., Chicago, Ill.; $100,000; Chas. M. McMahon, F. M. Doyle, Robert Doyle.——Palmyra Electric Light & Power Co., Palmyra, N. Y.; $10,000.——Meredith Electric Light Co., Meredith, N. H.; $8,000.

CONTRACT PRICES.

ROCK EXCAVATION.—Boston, Mass.—The following bids were received by Lieut.-Col. S. M. Mansfield, U. S. Engineer Office, Feb. 23, for removal of ledge from Gloucester Harbor: G. W. Townsend, Boston, $15.94 per cu. yd.; H. H. Sturgis, Bonny Eagle, Me., S. S. Andrews, Gorham, Me., and Thos. Liddle, East Boston, $12.45; H. W. Phillips, Quincy Point, Mass., $21.45; Enoch Townsend and C. W. Johnston, Somers Point, N. J., $9.86; R. H. Rogers and J. J. Fitzpatrick, Plattsburg, N. Y., $12.80; John Austin, Philadelphia, $14.37; Thos. Symonds, Manchester, Mass., $17.50.

ELECTRIC LIGHTING.—Omaha, Neb.—Bids for electric street lighting for three years were received, according to the "Bee," from the local company, at $132 per year per light for 200 or more 450-watt lights, and from Pardee & Co., representing the Jenney company of Fort Wayne, who propose to furnish the same lights, to burn from twilight to daylight, at $112 each per year. The latter bidders would expect a reasonable franchise for commercial lighting.

PIPE.—Kalamazoo, Mich.—Press reports state that the following bids have been received for a supply of 10 to 4-in. pipe: Addyston Pipe & Steel Co., $19.55 per ton for pipe and $42.50 for special castings; Chattanooga Foundry & Pipe Wks., $21 and $50; R. D. Wood & Co., $22.40 and $50; Dennis Long & Co., $22 and $45; Lake Shore Foundry, $19.60 and $45; Howard-Harrison Iron Co., $20.75; Jas. B. Clow & Son, $22 to $22.95 and $45 to $50.

PIPE AND HYDRANTS.—Cleveland, O.—It is stated that the lowest bid for a supply of 48 to 3-in. cast iron pipe was that of Jas. B. Clow & Co., Chicago, at $17.50 to $19.50 per ton, and that last year the city paid $23.10 per ton. For fire hydrants the Crane Co., Chicago, bid $24 each for 4-in. nozzles and $50 each for 6-in.; R. D. Wood & Co., $24.20 and $37; Jas. Flower & Co., $25.50 and $38.50.

GRANITE BLOCKS.—Baltimore, Md.—The following contracts have been awarded for granite paving blocks: McClenahan Bros., Port Deposit, 50,000 each at $54.50, $56.50 and $58.50; Rockport Granite Co., 50,000 each at $59.25, $59.50 and $59.80; Wm. Booth, 100,000 at $59.50; Westham Granite Co., 100,000 at $59.85; Alonzo Abbott, 50,000 at $59.85.

BRICK PAVING.—Cedar Rapids, Ia.—Bids for paving with one course of brick upon 6 ins. of macadam and sand have been received from the following bidders: 1. J. E. & C. P. Murray; 2. Des Moines Const'n Co.; 3. Henry Besler, Cedar Rapids; 4. Dubuque Const'n Co.; 5. J. B. Smith & Co., Chicago; 6. Rockford Const'n Co.; 7. J. P. Calnan Const'n Co., Clinton; 8. A. H. Connor & Co., Cedar Rapids. The bids were as follows:

	1.	2.	3.	4.	5.	6.	7.	8.
	$	$	$	$	$	$	$	$
Paving, per sq. yd.	1 68	1.38	1.58½	1.49	1.57*	1.59	1.66	1.49⅞
Reset. old curb, per lin. ft.	.15	.10	.15	.10	.10	.10	.10	.15
Limestone curb, per lin. ft.	.55	..	.55	.47	.68	.55	.60	.56
Cement " "	.50	.48	.45	.48	.50	.50	.55	.49
Extra exc'v., cu. yd	.25	.20	.25	.20	.30	.27	.20	.22½
Extra macadam, per cu. yd.	1.55	1.50	1.50	1 50	1.60	2.00	1 75	2.00

* $1.44 if Des Moines brick is used.

New Orleans, La.—Bids for paving Gravier St. with vitrified brick upon concrete, including excavation, etc., were received from: (1) Wood & Co., (2) Chas. Babst & Co., (3) F. Jahncke, (4) J. J. Frawley, (5) A. T. Price, as follows:

	1.	2.	3.	4	5.
Paving, per sq. yd.	$2.88	$3.15	$3.00	$2.65	$2 50
New curb, per sq. ft.	.55	.53	.50	.65	.55
Curb reset, per lin. ft	.15	.14	.15	.20	.12
Concrete gutters per sq. ft.	.20	.23	.20	.25	.25
Drain pipe, per lin. ft.	.70	.80	.90	1.00	1 00
Brick in culverts, per M	25.00	28.60	32.00	31.10	30.00
Cast iron bridge plates, per lb.	.03	.03¼	.03	.03½	.03¼
Wheel guards, each	16.00	18.00	20.00	.03½*	....
Concrete paving, per sq. yd.	1.50	1.80	2.25	2.00	1.40

* 3½c. per lb.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

SETTING GAS LAMPS.—Brooklyn, N. Y.—Bids are asked until March 9 for setting gas lamps in five streets. Alfred T. White, Comr. Cy. Wks.

COURT HOUSE.—Springfield, Mo.—An election will be held in Greene county March 27 to vote on an issue of $60,000 of bonds for a new county court house.

WALL.—Albany, N. Y.—Bids are asked until March 8 for constructing a dry rubble wall on the north side of Erie Canal, in Rochester. Edward Hannan, Supt. Pub. Wks.

ROUND-HOUSE.—Laramie, Wyo.—Press reports state that the Union Pacific Ry. Co. will erect a $65,000 round-house and make other improvements in the shops at this place.

CANAL IMPROVEMENTS.—Kearney, Neb.—It is reported that work will soon be commenced on improvements to the canal, estimated to cost over $100,000 and that the capacity will be increased nearly fourfold.

EXCAVATION.—New York, N. Y.—The department of parks will receive bids until March 7 for about 600 cu. yds. of earth and 9,000 cu. yds. of rock excavation from the gore of land north of 153d St., between Seventh Ave. and Macomb's dam road, for an approach for the new Macomb's dam bridge.

GAS PLANT IMPROVEMENTS.—Tallahassee, Fla.—The Capital City Light & Fuel Co. has been organized with a capital stock of $30,000 and will improve and enlarge the gas works, which it has purchased. Pres., W. M. McIntosh, Jr.; Secy., W. A. Rawls.

DRAINAGE WORK.—Marine City, Mich.—Harrison H. Butler, Co. Drainage Comr., will award contracts for 25 miles of drainage work. P. Shea, Engr., writes us that the ditch will be 35 ft. wide and have an average depth of 6 ft. The soil is soft muck.

Wabash, Ind.—Press reports state that the county commissioners have filed reports for altering, widening and deepening the channel of Eel River for a distance of 20 miles in Whitely county. The work would reclaim 20,000 acres of marsh land and is estimated to cost nearly $100,000.

Ocala, Fla.—It is reported that a canal 11 miles long and 30 ft. wide is to be excavated in Marion county to reclaim a large tract of submerged land and to float lumber rafts; estimated cost, $75,000. Engr., D. D. Rogers, Ocala.

INDUSTRIAL NOTES.

THE MILWAUKEE BRIDGE & IRON CO., of Milwaukee, Wis., has received a contract for two iron bridges in the town of Pine River, Wis.

THE COLORADO FUEL & IRON CO., of Pueblo, Colo., is said to be negotiating $3,000,000 worth of bonds with a view to largely increasing the capacity of its plant.

THE GATES IRON WORKS, of Chicago, Ill., have purchased the plant of the Chicago Iron Works, which will considerably enlarge the firm's facilities for the manufacture of heavy mining and milling machinery.

THE SAFETY CAR HEATING & LIGHTING CO., of New York, has received an order from the Long Island R. R. for the lighting of 55 new cars by the well known Pintsch system. Arrangements are also being made for the erection of a Pintsch gas-making plant at Long Island city.

THE INDUSTRIAL WORKS, of Bay City, Mich., have recently sold two of their heavy locomotive cranes to the Middlesex Quarry Co., Portland, Conn., and one 10-ton capacity crane to the New England & Western Granite Co., Mason, N. H. These cranes are to be used for shifting and loading cars.

THE DURHAM HOUSE DRAINAGE CO., of New York, has been placed in the hands of Caleb W. Durham, the president, as receiver. The company was incorporated in October, 1882, with a capital stock of $200,000, of which $163,300 was issued. Since last summer the company has been forced to enlarge its operations, and to undertake the entire plumbing work for buildings in which its system was used. It became impossible to procure the additional capital necessary, and, as a result, the company became insolvent. Several mechanics' liens have been filed against it. Liabilities, $82,616; assets, $12,111.

CARS.—The Mount Vernon Car Mfg. Co. has received an order from the Mobile & Ohio for 100 standard improved ventilated combination fruit and refrigerator cars of 60,000 lbs. capacity, equipped with air-brakes and Carson & Gurganus airtight doors. The company is also building a number of ventilated fruit cars of 60,000 lbs. capacity for the Florida Central & Peninsular. They are to be equipped with Westinghouse brakes.

The Litchfield Car & Machine Works are building 100 ore cars for the Duluth, Mississippi River & Northern.

The John M. Jones' Sons' car works, at West Troy, N. Y., have closed down because of lack of orders. Between 300 and 400 men are usually employed.

NEW COMPANIES.—Nova Scotia Development Co., Camden, N. J., $50,000; to construct docks, railways, etc.; Leonard Atwood, A. M. Chandler, G. A. Fletcher and others, of Philadelphia.——Duplex Improved Air-Brake Co., St. Louis, Ill.; $2,500,000; C. G. Stifel, Redmond Cleary, John Mullally, E. C. Donk.——Automatic Vertical Car Coupler Co., Gano, Ill.; $10,000; Otto Klein, M. W. Matson, Martin Yost.——Fort Worth Pump & Machinery Mfg. Co., Fort Worth, Tex.; $15,000; W. C. F. McKie, C. R. Brown, P. Hacket, C. F. Smith.——Electric Boat Co., Chicago, Ill.; $100,000; Charles D. Wright, D. Wright, John Templeton.——Whiting Foundry Equipment Co., Harvey, Ill.; $100,000; Nathan G. Moore, Wm. B. McIlvaine, Max Baird.——Whiting Car Wheel Co., Harvey, Ill.; $75,000; N. G. Moore, W. B. McIlvaine, Max Baird.——Garden City Street Cleaning & Sprinkling Co., Chicago, Ill.; $150,000; John S. Cooper, Andrew McDonald, David McGann.——American Stone Co., Chicago, Ill.; $125,000; Charles B. Garnsey, R. E. Ingalls, Charles C. Wilcox.——Illinois Refuse Furnace Co., Chicago, Ill.; $600,000; Clyde R. Bates, R. J. Cary, C. E. Soule, Jr.——Bower Machine Co., Chicago, Ill.; $40,000; C. O. Johnson, F. E. Taylor, J. F. Bower.——Twin Steel Water Arch Furnace Co., Augusta, Me.; $25,000; Pres., Geo. W. Cook, Boston; Treas., Osceola H. Abbott, New Bedford, Mass.

TO CONTRACTORS.

TOWN OF MELROSE, MASS.

Sealed proposals, indorsed "Proposals for Building a Section of the Melrose Sewerage System," will be received at the office of Walter C. Stevens, Engineer, Melrose, Mass., until Saturday, March 24, 1894, at 12 o'clock m. The award of the contract, if awarded, will be made by the Board of Sewer Commissioners of the town of Melrose, should such a board be elected at the next annual meeting, or by some other board or committee, hereafter duly authorized by said town. No bid will be received unless accompanied by a certified check for the sum of $500. All bids must be upon the blank forms furnished by this Committee, or by said Board of Sewer Commissioners, if elected. Plans can be seen and specifications and forms of contract can be obtained at the office of Mr. Stevens, as above. Each bidder will be required to give references that will enable the Committee or Board to judge of his skill and business standing. The Committee or Board having charge of the awarding of contracts are allowed and the right is reserved to reject any and all bids.

LEVI S. GOULD, Chairman.
JOHN P. BEERING, Secretary.
CHARLES W. HIGGINS.
JOHN ROBSON.
GEORGE L. MORSE.
CHARLES W. COOK.

A committee instructed to advertise for proposals. 9-2t

NOTICE TO CONTRACTORS.

SEWER MATERIALS.

Sealed proposals for furnishing brick cement and vitrified sewer pipe will be received by the Sewer Committee of the city of Newton, Commonwealth of Massachusetts, at the office of the City Engineer, City Hall, West Newton, Mass., until 12 o'clock noon of March 8, 1894. The award of the contract, if awarded, will be made as soon thereafter as practicable.

All proposals must be made upon a blank form furnished by the city, and must be accompanied by a certified check for two hundred dollars ($200) drawn upon some National Bank of Newton or Boston, and made payable to the City Treasurer.

The approximate amount of materials required is as follows:

2¼ million hard-burned brick.
9,000 barrels American cement.
1,000 barrels Portland cement.
34,000 lin. ft. of 4-inch vitrified sewer pipe.
4,000 lin. ft. of 5-inch vitrified sewer pipe.
5,000 lin. ft. of 6-inch vitrified sewer pipe.
45,000 lin. ft. of 8-inch vitrified sewer pipe.
9,000 lin. ft. of 10-inch vitrified sewer pipe.
3,000 lin. ft. of 12-inch vitrified sewer pipe.
8,000 lin. ft. of 15-inch vitrified sewer pipe.
3,000 lin. ft. of 18-inch vitrified sewer pipe.
350 lin. ft. of 20-inch vitrified sewer pipe
250 lin. ft. of 24-inch vitrified sewer pipe.

The committee reserve the right to reject any or all proposals if they deem it for the interest of the city to do so.

Specifications and forms of contract may be obtained at the office of the City Engineer.

HENRY H. HUNT,
Chairman Joint Standing Committee on Sewers.
H. D. WOODS, City Engineer.
8-2t

LEBANON, IND., WATER-WORKS.

SEALED PROPOSALS WILL BE RECEIVED until 2 o'clock p. m. of THURSDAY, March 15, 1894, by the City Council, for the following items for the Lebanon, Ind., Water-Works:

Seven hundred and fifty-two (752) tons of cast iron water pipe from four (4) to twelve (12) inches diameter.

Thirty-eight thousand (38,000) pounds of special castings for above pipe.

Ninety-three (93) double nozzle fire hydrants.

Seventy-nine (79) stop valves, and seventy-nine (79) stop boxes for above pipe.

Laying of above pipe and setting of above special castings, fire hydrants, stop valves and stop boxes.

One brick pumping station and brick chimney.

The driving and connecting together of a system of driven wells.

Two (2) compound condensing duplex direct-acting pumping engines, each of seven hundred and fifty thousand (750,000) gallons nominal daily capacity, together with two (2) return tubular boilers and all appurtenances necessary to complete said machinery.

One steel stand-pipe and masonry pier.

Proposals must be made on the blank forms furnished by the City Council of Lebanon, Ind., and all legal formalities must be complied with to secure consideration of proposals. The preliminary bonds and date of furnishing materials and completion of work must be filed to constitute a formal proposal.

Plans of above work may be examined and blank forms of proposal and specifications can be obtained at the office of the City Council, Lebanon, Ind., or the office of the Engineer, 35 and 36 Glenn Building, Cincinnati, O.

The proposals must be sealed and addressed to the City Council and be indorsed by the name of the person, firm or corporation which makes the tender, and be accompanied with a certified check payable to the order of the City Clerk, as follows:

Water pipe and special castings	$500.00
Fire hydrants	300.00
Stop valves	200.00
Pipelaying	200.00
Pumping station and chimney	200.00
Pumping machinery	300.00
Stand-pipe	200.00
Pier for stand-pipe	200.00

The City Council reserves the right to reject any or all proposals.

JESSE NEFF,
J. M. BECHTELL,
GEO. W. CAMPBELL,
E. D. BUSBY,
N. HAZELRIGG,
G. F. L. ESSEX,
Committee on Water-Works.

JOHN W. HILL, Engineer, Cincinnati, O.
Lebanon, Ind., Feb. 19, 1894. 9-2t

NOTICE TO CONTRACTORS.

CONSTRUCTION OF A 36-INCH CAST IRON CONDUIT.

The committee on an additional water supply of the city of Waterbury, Connecticut, will receive sealed proposals for trenching, refilling, delivering and laying Section two of a 36-inch cast iron conduit pipe, from the Wigwam Reservoir to the city of Waterbury, until 7:30 o'clock p. m., of the 9th day of March, 1894, at which hour the bids will be publicly opened and read in the office of the Mayor of said city at the City Hall.

Bidders are required to state in their proposals their names and places of residence. Each proposal shall be signed by the bidder or bidders making the same, and accompanied by a bond of One Thousand Dollars ($1,000) conditioned for the execution of the contract within the time specified in this notice, in case the bid be accepted.

A certified check for One Thousand Dollars ($1,000), payable to the order of the city of Waterbury and deposited with the city clerk of Waterbury, must accompany this bond. Blank forms for the bond will be furnished by the engineer.

The person or persons to whom the contract may be awarded will be required to attend at this office with the sureties offered by him or them and execute the contract within 10 days from the date of the award, and in case of failure or neglect so to do he or they will be considered to have abandoned it and as in default to the city of Waterbury.

The amount of the bond required with the contract will be equal to fifteen (15) per cent. of the total contract price.

The sureties required must be residents of the town of Waterbury, owning sufficient real estate within the limits of said town, or some surety company authorized by law to do such business within the state of Connecticut.

The right to reject any or all the proposals is reserved by said committee, if deemed for the interest of the city.

Section two will include that portion of the conduit from Station 160 to the Waterbury town line, about three miles.

The engineer's estimate of work and materials by which the bids will be tested will be furnished with the blank form of proposals.

The quantities are to be considered as only approximate and given merely as a basis of comparison. The committee expressly reserves the right of increasing or diminishing the same as may be deemed necessary by the engineer.

Specifications, blank forms and all available information will be furnished to intending bidders calling in person at the office of the engineer.

The proposals must be made upon blank forms furnished by the engineer, and all proposals will be considered as informal which are not in all respects in conformity with this notice.

By order of the committee on an additional water supply.

R. A. CAIRNS, City Engineer.
Office Room 24 Bohl's Building,
65 Bank street, Waterbury Conn.
February 24, 1894. 9-1t

WATER-WORKS, SALTSBURG, PA.

PROPOSALS WANTED.

The borough of Saltsburg, Pa., desires proposals for the building of a water-works plant, consisting of a pumping station, with the necessary building, having a capacity of 750,000 gallons in twenty-four hours; a reservoir to contain 750,000 gallons and a pipe system requiring 192 tons of pipe of 2,240 lbs. each and 7,800 lbs. of special castings, as follows: 8,030 feet of 4-inch, 1,910 feet of 6-inch, 2,900 feet of 8-inch standard pipe and 1,700 feet of light 8-inch pipe, 19 fire hydrants, 21 valves and 20 valve boxes.

Plans and specifications can be seen at the office of the undersigned, and bids will be received by him either for the whole work complete or for materials and labor separately until Saturday, March 10th, 1894, at 12 m.

A certified check for 5% of its amount must accompany each bid, and the borough reserves the right to reject any or all bids.

ROBT. H. WILSON,
Engineer, Saltsburg, Pa.
Of Wilson and Smith. 8-2t